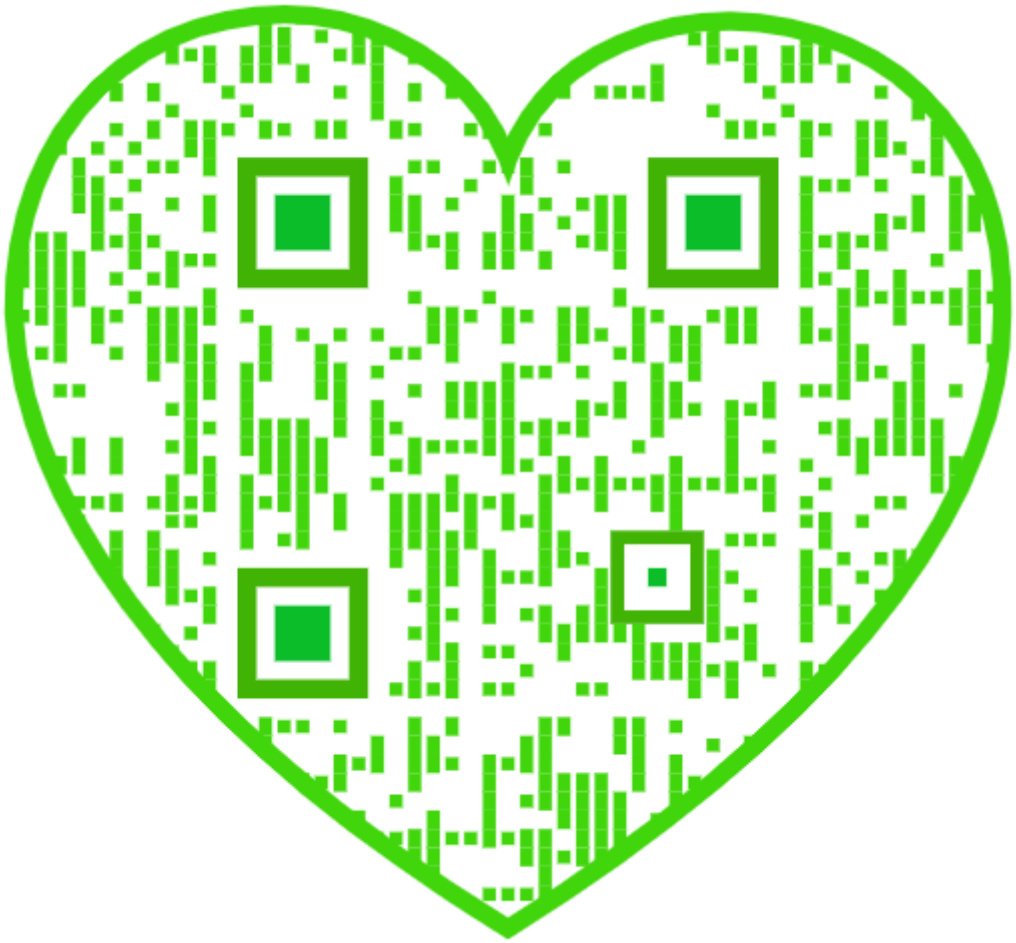

KRÜSI'S DRAWING.

MANUAL FOR TEACHERS.

INVENTIVE COURSE—ANALYTIC SERIES.

BY

HERMANN KRÜSI, A.M.,

INSTRUCTOR IN THE PHILOSOPHY OF EDUCATION AT THE NORMAL AND TRAINING SCHOOL, OSWEGO, N. Y.; AND FORMERLY TEACHER OF DRAWING IN THE HOME AND COLONIAL TRAINING SCHOOL, LONDON.

"Painting, or art generally as such, with all its technicalities, difficulties, and particular ends, is but a noble and expressive language; invaluable as the vehicle of thought, but by itself nothing."

RUSKIN.

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PREFACE.

THE Analytic Series of this system of drawing differs from the Synthetic, not only in the more elaborate finish of the designs, but in regard to the fundamental principle upon which the designs are constructed.

To analyze is to divide a whole into parts, and analytic drawing requires, first, that the outline of the whole space including the design shall be considered; and, second, that this space shall be divided into definite parts by lines drawn between points which mark the proportional division of the external lines.

It will be seen that such a course requires careful comparison and accurate judgment in regard to proportion and symmetry, and higher mental processes than are brought into exercise in the synthetic course. For acquiring skill in construction, and for developing taste in regard to form, the inventive process is still continued; and it is the firm conviction of the author that the designs produced by the inventive process, however crude and imperfect, stimulate the mind more power-

fully in the right direction than the mere imitation of the best works of art.

The knowledge of form, derived from actual work in invention, will give to pupils a better appreciation of the designs of the applied course, and especially of the mathematical proportions observed in the forms of the higher animals and of man. It will be seen that, in nearly every design, the outlines may be brought within the limits of some simple geometric figure. These figures may be treated in the same manner as the construction-lines of an outline map, and afterward the real forms may be filled in precisely as in map-drawing.

A brief study of these outlines and proportions will enable pupils to draw animal and human forms accurately at will; and the possession of this ability is so important that teachers should give prominence, not only to the designs of this character in the books, but should encourage independent investigation in this direction.

In conclusion, the author would express his thanks to Prof. James Johonnot, of the South Missouri Normal School, for his practical aid and suggestions in adapting this work to the wants of American schools, and for his unwearied interest in the subject. In the introduction to the present volume, he has assigned to drawing a high place as an instrumentality for the full and healthful development of all the mental faculties. This rank, though fully deserved, is scarcely yet recognized by the public generally.

The author would also acknowledge his indebtedness to Miss Emma Hutchins, of the Oswego Normal School, for the preparation of a large number of the designs in

the applied course, many of which have been copied from Nature; and to Miss Emma Dickerman, of the South Missouri Normal School, for many of the most tasteful designs in the inventive course.

OSWEGO, N. Y., *January* 15, 1873.

INTRODUCTION.

THE value of drawing, as an educational exercise in our schools, is just beginning to be appreciated in this country. Hitherto it has been generally viewed as a mere accomplishment, and as attainable only by the favored few. A child with a natural aptitude for delineating forms has usually been regarded as a prodigy not subject to ordinary limitations; and the fact of his representing forms successfully has seldom been considered as indicating the possibility of others doing like work.

Drawing also has been largely regarded as of no practical value in an educational course. The only end supposed to be gained was the power to make pictures; and this was considered of little worth unless the pupil intended to become a professional artist. The larger benefits derived from its exercise have been overlooked or ignored.

This low estimate of the importance of drawing is in part due to a general want of knowledge concerning its principles and practice. Comparatively few persons have either the ability to draw, or to determine whether a figure made by another is correctly drawn, or the reverse. Not appreciating the utility of the knowledge which comes from the study and practice of drawing, they have

no desire to inform themselves, and their attitude in the matter is that of direct opposition or of complete apathy.

Still another reason tells in the same direction. The teaching of drawing has been largely confined to the copying of pictures, reducing the exercise to one of mere imitation, and bringing into action none of the higher faculties of the mind. As a natural consequence, pupils generally have disliked the work, and their labors have been almost fruitless of good results. Children are wearied and disgusted by the endless repetition of unmeaning lines, and by copying pictures in which they take no interest, and which do not convey to them a single thought; and, when they grow up and take their places in society as parents or school-officers, it can hardly be expected that they will take a lively interest in drawing, or encourage its introduction into schools.

In spite, however, of ignorance, of apathy, and of hostility, and in spite of all obstacles, drawing is gradually and surely making its way into all grades of our schools, and the conviction is rapidly growing that there are few studies that can be introduced into a general school-course of greater intrinsic value.

DRAWING AS A MEANS OF MENTAL DEVELOPMENT.

The value of drawing will be best appreciated when we understand its precise nature, and the relation it sustains to other branches in the course of instruction. Drawing is a method of expressing thought, and philosophically is associated with other forms of language. Like language, it should be regarded as a means, and not as an end. It is valuable as embodying thought, and as a mode of communicating thought to others; but, divorced from thought, it is but a lifeless form. Picture-making may become mechanically perfect, but, unless it embodies and expresses the thought of the artist, the pro-

cess is valueless in an educational point of view. Not only should the whole picture express a thought, but each line and mark should be necessary to the complete expression, or it is superfluous, and, as such, a hinderance rather than a help.

ATTENTION.—In all true educational work the primary attention should be fixed upon the thought, and the secondary on the expression. Thus, in the study of any of the sciences, when books are used, the great effort should be to understand the ideas recorded, and the words should be considered useful only as they fully express these ideas. Vagueness of expression more often results from vagueness of thought than from any lack in the use or arrangement of words, and improvements in modes of speech must come largely from a more clear comprehension of the thought involved. As drawing is but a kind of language, the primary attention should be fixed upon the form to be portrayed, while the method of representing the form should be as nearly incidental as possible. When the lines drawn are imperfect, the correction should be made by more accurate observation of the form itself, rather than by calling the attention specially to the faulty expression.

OBSERVATION AND PERCEPTION.—It will be seen, then, that drawing makes a continuous demand for close and accurate observation, thus cultivating the perceptive faculties, and storing the mind with distinct ideas of form. It leads also to comparisons and nice discriminations, and fixes the attention upon real objects. When the perception is once developed by means of these exercises, activity and keenness of observation become fixed habits of mind, increasing thought, broadening culture, and enriching life.

But expression must always accompany thought. Words are used to embalm general ideas, and drawings

are made to clearly define and preserve ideas of form. The hand must be trained to express what the eye perceives. Careful practice alone can accomplish this. When, after repeated trials, the lines drawn fail to represent the form desired, the difficulty will probably be found in defective observation rather than in any fault of the muscles.

The education of the hand, so that it is brought into exact harmony with the eye, and obeys the mandate of the will instantaneously, is an educational achievement of immense importance in all the vocations of life. The effort to express also corrects observation, and thus perception and expression mutually act and react, stimulating, criticising, and correcting each other.

IMAGINATION AND REASON.—Not only does drawing assist in the cultivation of perception, but it also may be made an important auxiliary in the development of the higher faculties. In all of the inventive work of drawing, the imagination is brought into active exercise, and perhaps no better school-work was ever devised for that purpose. The first efforts at invention may prove failures, from the fact that imagination has not been awakened. The mind has been accustomed to move along the path of the real, imitating and accepting without any effort at rearrangement or new combination. The creative energies of the mind have not been called into action. Thought remains under the domain of the senses, and is confined to that which is visible. But by simple and progressive steps the mind is led away from the actual and toward the ideal. By the judicious instruction of the teacher and the stimulus of example, the imagination is at last aroused. The possibility of creating new figures and designs becomes a living reality. The newly-acquired consciousness of power to do, stimulates the mind to greater activity, and leads it to higher achievement.

The imagination, however, which concerns itself with rearrangements without regard to order, must be directed so that the new combinations may produce definite results. The designs produced should be orderly, harmonious, and symmetrical. The faculty which perceives the relations upon which these qualities are founded, and which directs and controls the imagination, is reason. Every drawing-lesson, then, may be made to fulfill the highest function of school-recitations, that of bringing into active use all the powers and faculties of the mind, in their natural order.

To produce these results by drawing exercises, the inventive and applied courses are both indispensable. If the inventive work is omitted, little or no exercise is given to the imagination; and merely copying pictures which others have drawn, fails to bring into active use the higher powers of the mind. If the applied course is omitted, the imagination is not brought under the wholesome control of reason, and made to conform to the actual, but runs riot and wastes itself in objectless pursuits.

Conception.—In its full development, the mind must have the power to form mental images of things unseen. It must vividly recall the actual, and as vividly construct mental pictures of the ideal formed by rearranging the elements of the actual. This process, combining vivid perception and recollection with imagination, is known as conception, and the picture so formed is called a concept. By drawing, we obtain more vivid concepts of form than by any other means. The effort to represent corrects errors of perception, errors of recollection, and errors of imagination; and, when the drawing is perfected, the concept stands out clear and sharply defined. The mental act of thus defining concepts in the concrete becomes a confirmed habit of the mind which extends to every possible department of thought.

TASTE.—In the construction of a design or a picture, and in the arrangement of its parts, certain laws in regard to proportion, harmony, and symmetry, must be observed, to produce a pleasing effect. By exercise, and without a knowledge of the laws upon which the true order rests, the eye may learn to distinguish with great accuracy the correct from the incorrect, the true from the false. This perception of the true order of things by an intuitive or empiric process we call taste. Taste arrives at results without resort to reasoning, and, when cultivated and emancipated from the control of custom or prejudice, its decisions will generally be found to correspond with law. It is an elevating and refining influence, tending to beautify and enrich life, and to soften the asperities of social intercourse.

Taste is directly cultivated by drawing. The eye, trained to definite and accurate observation, becomes conscious of the natural and true order; and the hand, trained to execute, reproduces this order in all its exactness. Taste, cultivated in regard to form, leads to the observance of good taste in the arrangement of things, in the use of language, and in social manners.

DRAWING AS AN AID TO SCIENCE.

As drawing is an expression of thought, its practice leads directly to the acquisition of the materials of thought. An investigation of things themselves gives us real knowledge; a talk about things yields only apparent knowledge. Drawing as a school-exercise should be largely pursued in connection with other branches of learning, and in the pursuit of real knowledge. The study furnishes the thought, the drawing expresses it. But, in the expression, the mind is led to more accurate observation, and the interest that results leads it directly to deeper investigations and larger acquisitions.

For example, by drawing the leaves, the flowers, the fruit, the stems, and the roots of plants, the mind first observes the individual forms, then the relations which exist between the forms of each class, and finally the larger relations which exist between the different classes. From this observation of form it is but a step to the consideration of the relations of parts to each other, to functions, and to methods of growth. In this manner systematic botany and vegetable physiology grow directly out of the knowledge which is forced upon the mind by drawing.

The same is true in regard to animal life. The pupil begins to draw the outline of some of the more simple and familiar specimens, as butterflies. He soon discovers that, while there is a general resemblance in form in all, there are differences more or less marked in the different species. This leads him to a more extended comparison, and he soon is intent on observing the likeness and unlikeness between the different specimens which he examines. This comparison, finding resemblances in generals, and differences in special details, is the real basis of philosophic classification, and the pupil reaches this result by the true inductive process, and as an incident of work apparently in another direction.

All the branches of natural history and nearly every science afford similar illustrations of the importance of drawing in the acquisition of materials of thought. Indeed, without an attempt at drawing, it is scarcely possible for students to observe all the nice distinctions and infinite graduations of form which characterize and individualize objects.

The artist, to be successful, must have a knowledge of actual forms in nature as a basis for his work. Accurate observation furnishes him with food for his imagination, and out of the elements so obtained he fash-

ions his wonderful creations. Conforming to natural forms and plans, his productions are beautiful and ennobling; violating these conditions, either through ignorance or design, they are distorted and grotesque. Excellence in art is attainable only by a loyal adherence to laws discovered by an examination of Nature's works.

The negative importance of drawing in this connection is shown by the fact that, while it stimulates the mind to genuine investigation, and to the acquisition of real knowledge, it implants in it a dislike for mere memorizing processes, and for apparent knowledge.

The student who studies Nature, "that elder scripture writ by God's own hand," with ready pencil, recording his observations by its aid, each day finds his search is keener, his comprehension larger, and his insight deeper; because, to represent, he must know; and, to know, he must examine minutely and reason accurately.

DRAWING IN ITS PRACTICAL VALUE.

Besides its importance as an educational process, drawing is of great practical value in most of the vocations in life. It is indispensable to the highest success in most of the mechanical pursuits. The man who can illustrate his ideas with his pencil, rises from the lower to the higher walks of his calling. He plans as well as executes, and he falls naturally into his place as leader and director. The carpenter who draws well, becomes foreman, and not unfrequently architect. The machinist who draws, in many instances, becomes a successful inventor.

Ability to draw is of great value to the farmer. By its means he plots his ground and divides his fields. By it he plans his house, adapting it to its surroundings and to its uses. By it he is able to describe the peculiar vegetation, the name of which is unknown to him, and

the kind of insect which destroys his crop. By it he fashions his utensils and tools, and communicates his thoughts to others in a thousand instances where ordinary language fails.

In the various manufactures, workmen are in constant demand who have some aptitude and skill in designing. In engineering and in architecture, drawing is an integral part of the professional work. Even to those engaged in the learned professions, drawing may be made of use in various kinds of investigation, and in affording amusement for leisure hours.

WHO SHOULD LEARN TO DRAW.

It has been well said that "any one who can write, can draw," and it may be added that any one, who is not suffering directly under some physical disability, may learn to draw. As in other branches of education, some will have a greater aptitude for the work than others, but all can make some proficiency in acquiring skill in its execution, and obtain some positive advantage from its exercise.

In consequence of its importance in educational work and in practical life, and of the fact that all may acquire some skill in its practice, drawing should be introduced into every grade of school throughout the length and breadth of the country. When this is done, the exercise will go far toward selecting from the ranks those who are to be the future artists of the country, and of starting them in their career.

From the schools an army of workmen will graduate so trained that our manufactured and mechanical products will occupy as high a place, in regard to the beauty of their designs, as those of the most favored nation.

The nation and society at large will feel the impulse which comes from this practice of drawing in the common

schools in the improvement of individual taste, in the disappearance of tawdry ornaments from houses and from dress, and in the general advance of science and art.

By uniting drawing and the study of Nature, students are directed to original sources for their ideas of form, and they easily learn to distinguish the actual from the merely conventional. Drinking from the same fountain of inspiration as the great masters of ancient art, they no longer copy, but invent. From them we may expect new forms of art, rivaling the old in beauty and richness; and from the art so developed we may look for an influence which will react upon education, purifying, ennobling, and perfecting.

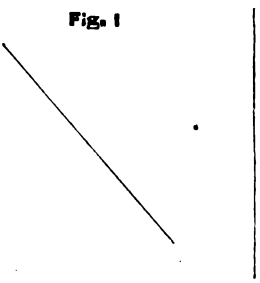
PRELIMINARY EXERCISES.

POSITION.

The Analytic Series of this system of drawing requires much greater accuracy in comparing and measuring than the Synthetic Series which precedes it. In order to make this accuracy possible, certain definite rules should be observed in regard to the position of the body, the hand, the pencil, and the paper.

First. The body should maintain an upright position as nearly as possible at all times. This position is necessary to preserve health, secure grace, and to enable the eye to fully observe the whole design and every part of it.

Fig. 1



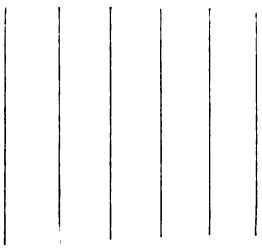
Second. The pencil, of moderate hardness and well sharpened, should be of sufficient length to rest upon the upper joint of the index-finger, while the pointed end is grasped by the index and middle fingers and the thumb.

Third. The paper or book should be kept in one position, and not turned around; but it may be moved to the right or left, to accommodate the direction of the lines to be drawn, as will be shown hereafter.

In writing, the relative position of the body and book is unchanged, as the letters uniformly extend in one

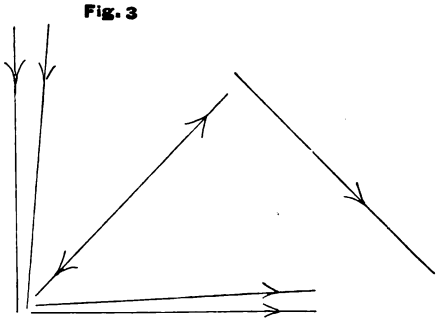
direction; but, in drawing, the lines extending in different directions are best drawn by changing the position of the paper. By practice it will be found that a vertical line, or one slightly diverging from a vertical direction, is most easily drawn by having the paper directly in front; a horizontal line, by placing the paper a little toward the right; and an oblique line to the left, as in Fig. 1, by placing the paper a little to the left.

Fig. 2



As a preliminary exercise, the teacher should require the pupils to draw a considerable number of each kind of these lines, so that they may become accustomed to the positions of the body, hand, pencil, and paper, which are required in accurate and rapid delineation. To accomplish this in

Fig. 3



classes, dictation exercises, practised simultaneously, are strongly recommended.

For example: The lesson is drawing vertical lines, as in Fig. 2. The pupils assume their proper position, with the paper directly in front, and, at the signal "Draw," commencing the line when the teacher counts *one*, and finish-

ing it when he counts *two*, the interval between the counts measuring the time taken for drawing the line.

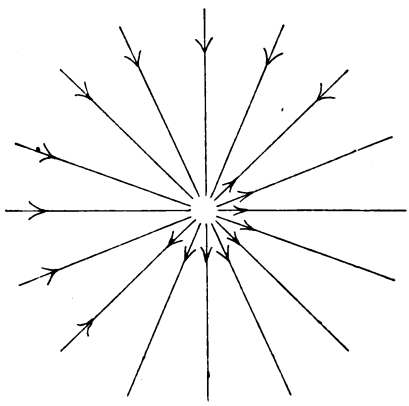
This practice has the effect to retard the motions of those who are apt to make imperfect lines through too much haste; and to accelerate those who are habitually slow, and perhaps indolent.

These dictation exercises should be used frequently throughout the entire drawing course. A few minutes during each lesson may be profitably spent in simultaneous drawing, in all the primary work, and the same exercise should be occasionally used in the higher series.

MOVEMENTS OF PENCIL.

Experience shows that the different lines are best drawn by moving the pencil in certain directions, and

Fig. 4



that attention should be given to these movements in the outset.

First. Vertical lines, or those nearly so, should be drawn from the top downward.

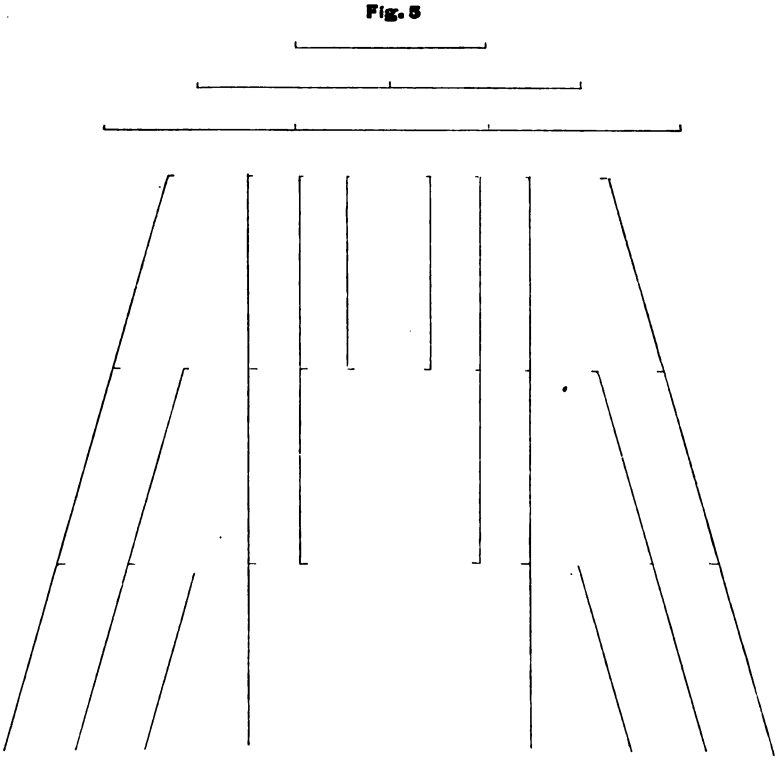
Second. Horizontal lines, or those nearly so, should be drawn from the left to the right.

Third. Oblique lines to the right, half-way between vertical and horizontal lines, should be drawn from the top downward.

Fourth. Oblique lines to the left, half-way between vertical and horizontal lines, may be drawn either from the top downward, or from the bottom upward.

In Fig 3, the methods of drawing these various lines are illustrated—the arrows indicating the direction in which the lines should be drawn in each case.

Fig. 3



In Fig. 4, sixteen lines are drawn about a common centre, the arrows showing the direction in which the lines are to be drawn. It will be noticed that only two

lines admit of more than one method in drawing, and these both lie in the same direction.

LINES OF DIFFERENT LENGTHS.

The next subject that demands attention is measurement. The teacher decides upon some definite length, as one inch, and the pupils are required to draw lines of this length in various directions, the teacher dictating and counting as before.

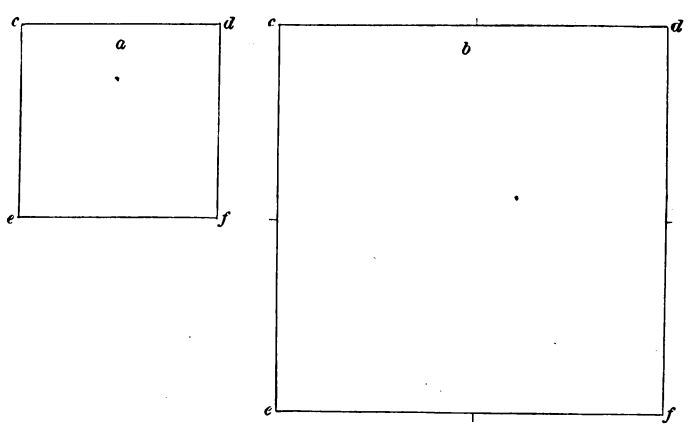
When considerable accuracy has been attained in drawing the required length at will, the exercise may be varied by drawing twice the standard length, the teacher counting *one, two, three.* Vertical, horizontal, and oblique lines should be drawn in this manner, as is indicated in Fig. 5. Lines three and four times the standard length should then be given, the teacher dictating as before, and counting one for each additional length.

COMBINING LINES INTO FIGURES.

To combine these lines into figures, dictation exercises may be used something as follows:

Draw vertical line, *c e*, in *a*, Fig. 6—*one, two.*

Fig. 6



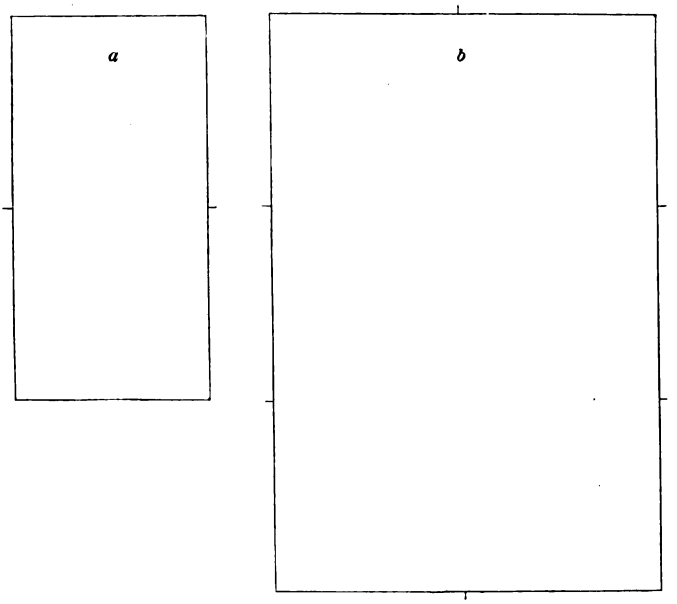
From upper end of vertical line drawn horizontal line to the right, as *c d*—*one*, *two*.

From lower end of vertical line draw horizontal line to the right, as *e f*—*one*, *two*.

Draw vertical line connecting the right extremities of the horizontal lines, as *d f*—*one*, *two*.

The result in this case is a square. In a similar

Fig. 7



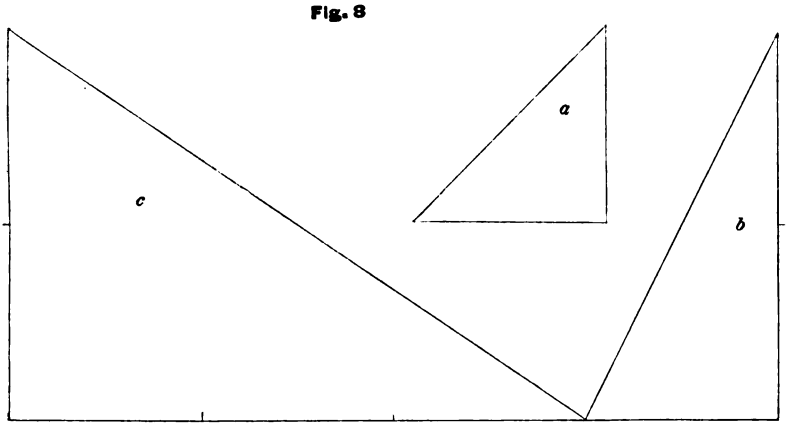
manner a square having sides of twice the standard dimensions may be drawn, as in *b*, Fig. 6.

An oblong may next be drawn with vertical sides of two dimensions and horizontal sides of one dimension, as in *a*, Fig. 7; or an oblong with vertical lines of three dimensions and horizontal lines of two dimensions, as *b*, Fig. 7.

This exercise may be varied in a great number of

ways by changing the dimensions of the sides drawn, or by substituting or adding oblique lines, as in Fig 8.

Fig. 8



DIVISION OF LINES.

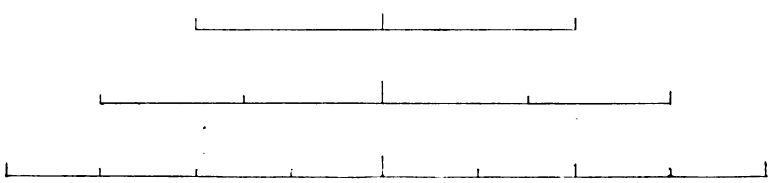
The preceding exercises have been given as preparatory to the true analytical work, which consists of divisions and subdivisions of lines and figures. The work of drawing lines of definite length, and of multiplying these lengths at pleasure, will be found to greatly facilitate the work of accurate division.

The preliminary analytic lessons cannot profitably be made simultaneous, as accurate division requires the exercise of judgment, which cannot at first be called into instantaneous action.

The division of lines may be commenced as follows: The teacher draws a line upon the black-board, and calls upon some member of the class to make a dot in the middle of it. The result is submitted to the class, and any one is allowed to make corrections in the location of the dot. The final result is then verified by actual measurement. When the division can be made with considerable accuracy, the term *bisecting* may be given.

This exercise should be continued with lines of different lengths and extending in different directions, until every member of the class can approximate to correct results.

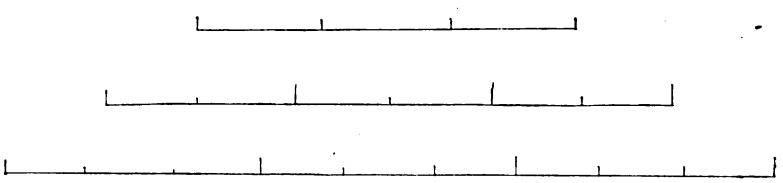
Fig. 9



The divisions are next bisected, and the whole line divided into four equal parts; and these divisions in turn are bisected, dividing the line into eight equal parts, as in Fig. 9.

To divide a line into three equal parts requires a still greater exercise of skill and judgment. The first steps of this exercise are similar to those described in bisecting the line, and, after the black-board lessons have been finished, the same exercise should be repeated upon the slate and paper. The term *trisecting* is then introduced and explained.

Fig. 10



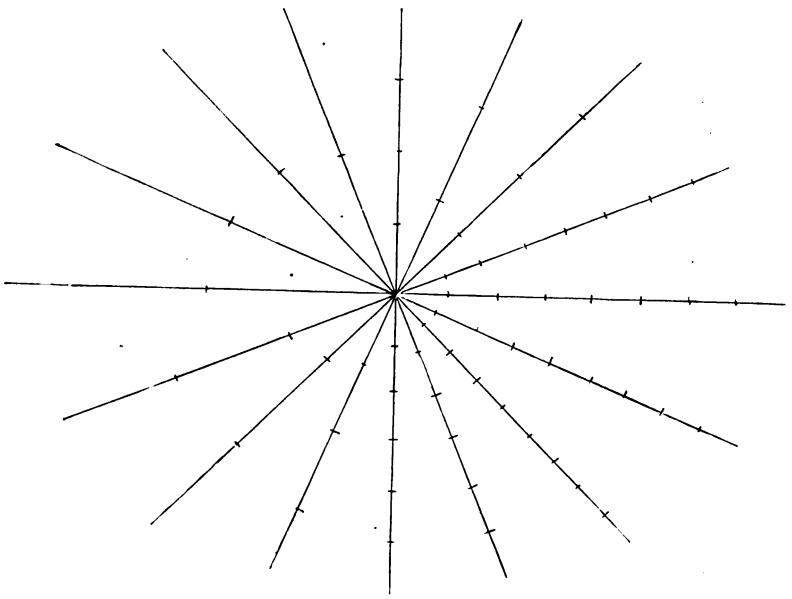
The three divisions of the trisected line, each, may be bisected, dividing the line into six equal parts; or, each may be trisected, dividing the line into nine equal parts as in Fig. 10.

The division and subdivision of lines of different

lengths, and lying in different directions, are further illustrated in Fig. 11.

The lines in this figure vary in length, so as to make the divisions of each an independent exercise, and the divisions vary from two to nine. It would be well for

Fig. 11



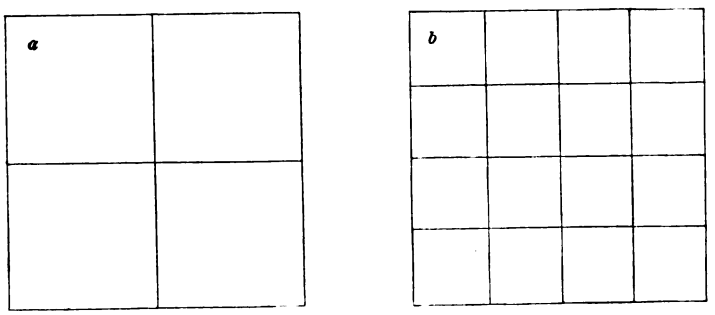
the teacher to draw the figure upon the board, and allow each member of the class to have a part in the division of the lines. The figure might afterward be drawn upon the slate or paper, and the divisions again indicated by each pupil.

RECTILINEAR FORMS.

BISECTIONS OF THE SQUARE.

A SQUARE may be divided into square sections by first placing dots at the middle of the lines that constitute its sides, and then connecting these dots by lines parallel to the sides, as in *a*, Fig. 12.

Fig. 12



A dictation exercise to divide a square into four equal parts may be conducted as follows:

First. Draw a square as directed in a former lesson.

Second. Bisect each side of the square by putting dots at the middle of the lines.

Third. Draw a horizontal line connecting the dots on the vertical sides.

Fourth. Draw a vertical line connecting the dots on the horizontal sides.

By bisecting each of the divisions of the square, and connecting the points with vertical and horizontal lines, the square is divided into sixteen equal parts, as in *b*, Fig. 12. This exercise may also be made simultaneous, the successive steps being dictated by the teacher.

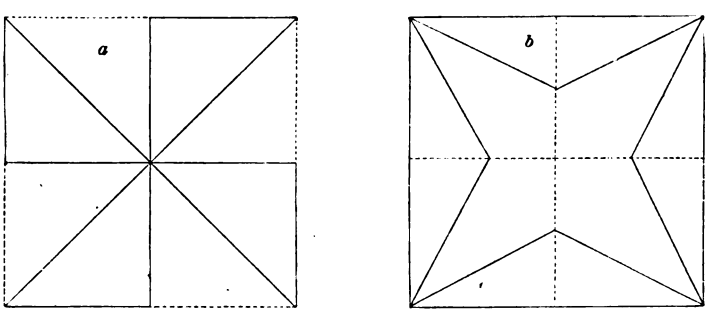
DESIGNS BASED ON BISECTION OF THE SQUARE.

At this point commences the true inventive work. From the foregoing divisions of the square, a great variety of designs may be constructed. A few of the more simple ones may be made the subject of dictation exercises, as follows:

First. Draw a square, and bisect it as in *a*, Fig. 12.

Second. Draw a line connecting left lower corner with right upper corner.

Fig. 13



Third. Draw a line connecting left upper corner with right lower corner. The term *diagonal* should here be introduced and explained.

Ques. What figures do you see now?

Ans. Eight right-angled triangles.

Fourth. Erase the left half of the upper horizontal line, and the right half of the lower horizontal line; also

erase the upper half of the right vertical line, and the lower half of the left vertical line, and we have a design, as in *a*, Fig. 13.

Ques. What figures have we now?

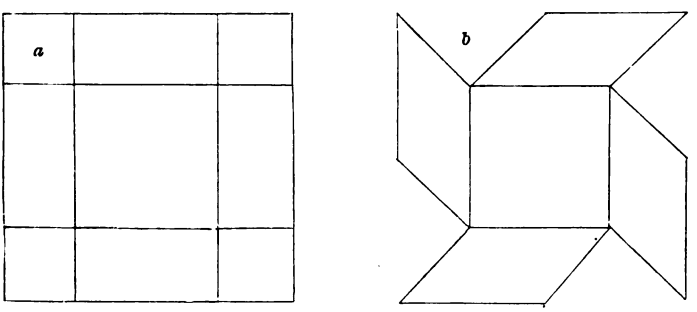
Ans. Four right-angled triangles.

Ques. How are they situated?

Ans. They are united at a common centre, separated at their extremities, and are so arranged as to form a regular and symmetrical figure.

Another design may be obtained by drawing a square, and bisecting it as before; bisecting each half of the interior lines, and marking the points by dots; drawing lines from each of the dots to the two nearest corners of the square; and lastly by erasing the horizontal and vertical lines inside the square, as in *b*, Fig. 13. In these figures, the dotted lines represent the portions to be erased.

Fig. 14



It will be noticed that these figures in their outlines are similar to those constructed by the inventive process of the synthetic series, differing only in the manner in which they are obtained.

It will be also noticed that these figures and others obtained by the division of lines are clearly defined, and more exactly symmetrical than those obtained by the synthetic process.

Another dictation exercise may be given, as follows:

First. Construct a square, and divide it like *b*, Fig. 12, omitting the central horizontal and vertical lines. The result will be a figure like *a*, Fig. 14.

Second. Draw lines connecting the corners of the interior square with nearest corner of the exterior square, beginning at the left hand upper corner.

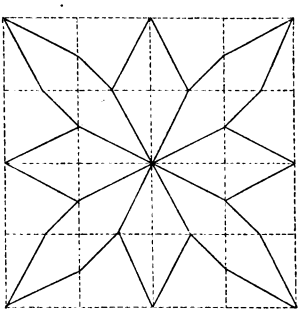
Third. Draw a line from each corner of the interior square to the centre of one side of the exterior square, the two upper ones to the right, and the two lower ones to the left.

Fourth. Erase the vertical and horizontal lines, lying between the interior and exterior squares.

Fifth. Erase each alternate half of the lines composing the exterior square, commencing with the left upper corner.

By this process we obtain a figure represented by *b*, Fig. 14, made up of four regular rhomboids, a result which may also be obtained by the inventive process of the synthetic series.

Fig. 15



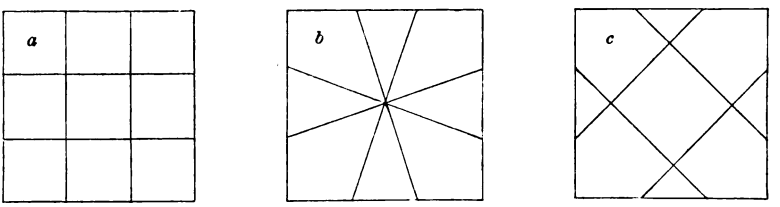
The above examples are sufficient to illustrate the process of dictation and simultaneous recitation. They will also be sufficient to give the pupil an idea of the nature of the work he has to do, and of the means of doing it.

The teacher should next call for designs from the pupils, based upon the divisions of the square into four and sixteen equal parts. One of the simplest of these is represented in Fig. 15, the dotted lines representing the original pattern, and the portions to be erased.

TRISECTIONS OF THE SQUARE.

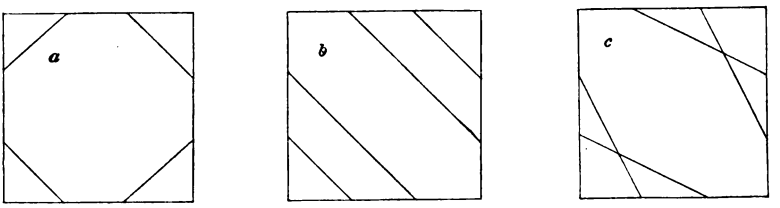
The sides of the square may next be divided into three equal parts, as before directed; and the dots may be connected by symmetrical lines, forming figures as

Fig. 16



shown in Figs. 16 and 17. These six varieties are the only regular figures which may be formed by simply uniting the dots by interior lines.

Fig. 17

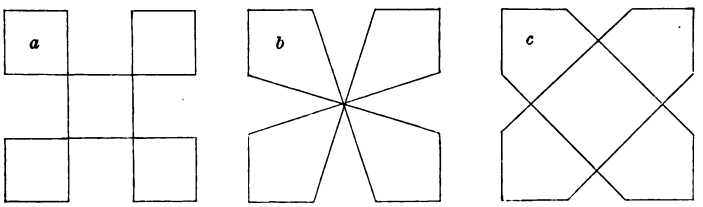


By erasing the central portions of the exterior lines in *a*, *b*, and *c*, Fig. 16, we obtain *a*, *b*, and *c*, Fig. 18, respectively.

By a slight modification of *a* and *b*, Fig. 18, the addi-

tion of a few lines, and the erasure of others, we obtain *a* and *b*, Fig. 19, respectively. In a similar manner from *c*, Fig. 18, we obtain *a*, Fig. 20, and by slight changes we have *b*, Fig. 20.

Fig. 18

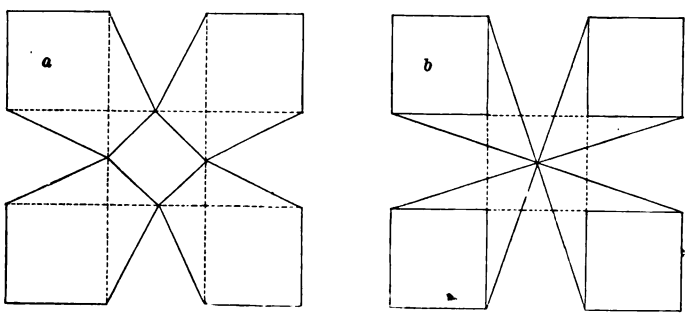


In each of these cases, and in all the subsequent figures, the lines to erase are indicated by dotted lines.

In each of these designs, and in others which may be invented, the teacher should call attention to its parts, and lead the pupils to observe of what regular figures it is composed.

For example, it will be seen that *a*, Fig. 19, is com-

Fig. 19

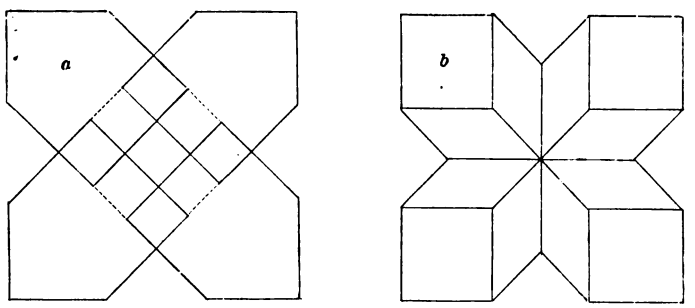


posed of four pentagons enclosing a small square; that *b*, Fig. 19, is composed of four squares, and four trapeziums with reëntrant angles; *a*, Fig. 20, of four pentagons

interlaced with each other; and *b*, Fig. 20, of four squares and eight rhomboids.

The areas of each of these figures may be easily cal-

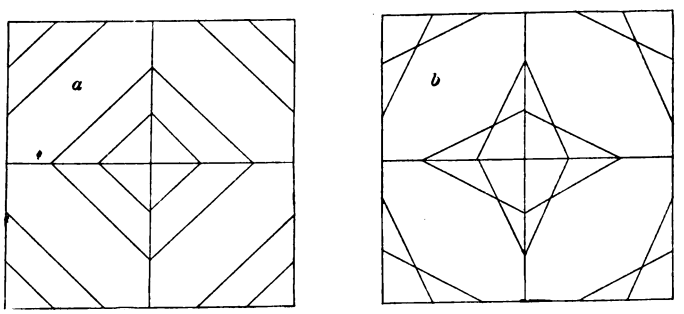
Fig. 20



culated, the process giving variety to the exercise, and leading the pupils to accurate observation and analysis.

For example, in Fig. 19, each of the pentagons will be found to contain thirteen-seventy seconds of the original square, and the interior square one-eighteenth of the whole.

Fig. 21



In *a*, Fig 20, each of the corner pentagons contain one-sixth of the whole, and the central square, two-

ninths; in *b*, Fig. 20, the corner squares, each contain one-ninth of the whole, and each of the rhomboids one-eighteenth.

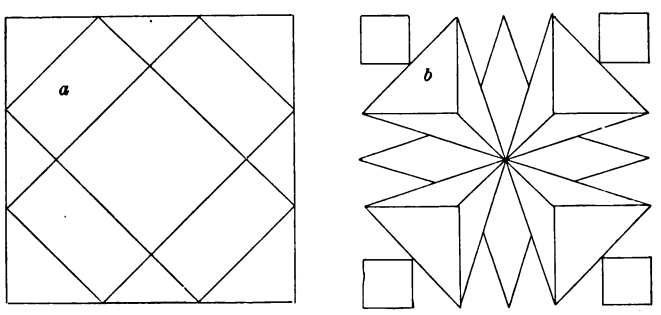
COMBINATION OF DESIGNS.

By combining the simpler designs already found in the squares, into larger squares, new designs are produced. For example, four figures like *b* and *c*, Fig. 17, when combined into a single square, produce figures like *a* and *b*, Fig. 21. These results please because of their symmetry, and of their being unexpected.

These designs may also be produced by the division and subdivision of lines, and the exercise may be made simultaneous, and by dictation if desired.

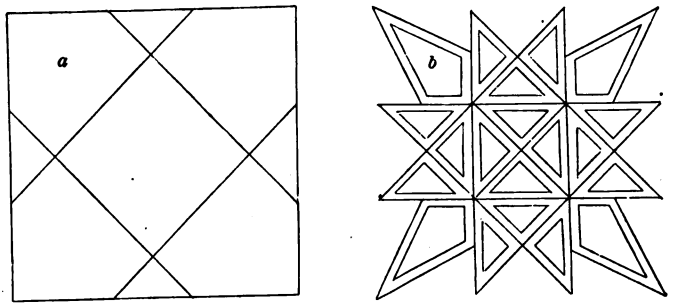
The pupils should next be encouraged to invent as many designs within the square as possible in the time assigned for these exercises. For this purpose, he may divide the sides into two, four, six, or eight equal parts, and draw such auxiliary lines or patterns as may best aid him in his work. We append a few of the patterns and completed designs in pairs as illustrative of what may be done, but not as figures to copy:

Fig. 22



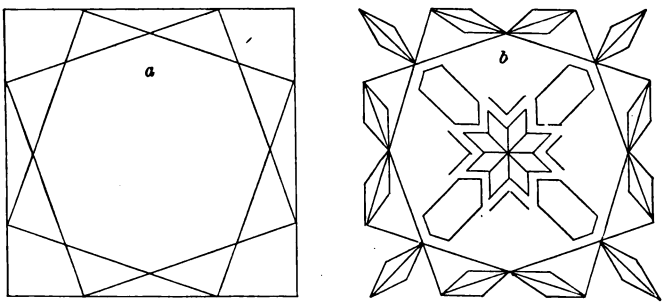
DIVISION INTO THREE EQUAL PARTS.

Fig. 23



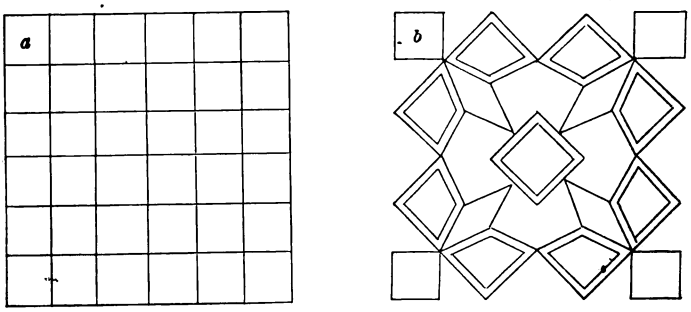
DIVISION INTO THREE EQUAL PARTS.

Fig. 24



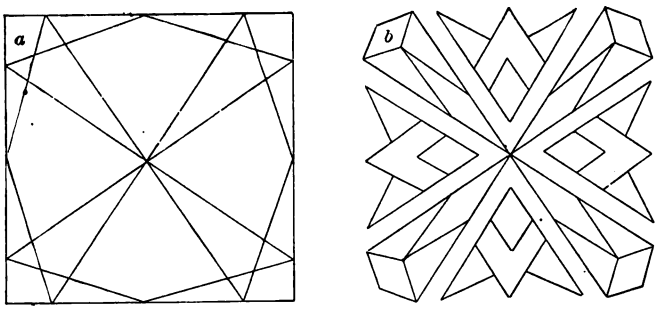
DIVISION INTO FOUR EQUAL PARTS.

Fig. 25



DIVISION INTO SIX EQUAL PARTS.

Fig. 26



DIVISION INTO SIX EQUAL PARTS.

It will be seen that the patterns will admit of a very great variety, and that there are practically no limits to the designs that may be produced.

As in all inventive work, the production of these designs will tend greatly to stimulate the observing faculties and lead to the cultivation of taste. Scarcely any single exercise in school combines so much that is calculated to secure true development as this.

The best of the designs invented should be placed upon the board from time to time, to stimulate all to higher attainments.

REGULAR OCTAGONS.

A regular octagon is a figure having eight equal sides and eight equal angles.

This figure may readily be drawn, as follows:

First. Draw a square with two diagonals.

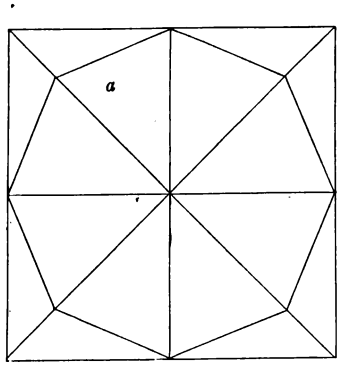
Second. Bisect each side of the square, and connect the points of bisection on opposite sides by lines.

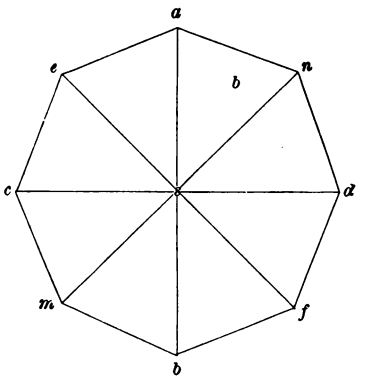
Third. From the centre, on each of the diagonals, mark a distance equal to the distance from the centre to the middle of one of the sides.

Fourth. Draw lines connecting the middle of the

sides with the points marked on the diagonals, and the octagon is complete, as in *a*, Fig. 27.

Fig. 27





A regular octagon may also be made by drawing a vertical and a horizontal line, mutually bisecting each other, as *a b* and *c d*, *b*, Fig. 27; then carefully bisecting the right angles by lines of the same length, extending through the point of intersection, as *e f* and *n m*. The extremities of all these lines will give eight points equidistant from the centre and from each other. The lines connecting them will form the octagon required.

This method is much more difficult than the former one, as it requires great care and skill to exactly bisect the angles.

DESIGNS WITHIN THE OCTAGON.

With the octagon as a basis, the pupils should invent designs as before in the square. This may be done by drawing diagonal and auxiliary lines, and by erasing portions of the patterns.

Simple designs may be made, as follows:

First. Draw an octagon with diagonals, connecting the opposite angles.

Second. Place a dot at the middle point of each half of these diagonals, and at the middle point of each of the sides.

Third. Draw a line connecting the dot upon each diagonal with that upon the nearest side.

Fourth. Erase each alternate half of the sides, commencing with the first to the right of the vertical diagonal. The result is the design *a*, Fig. 28.

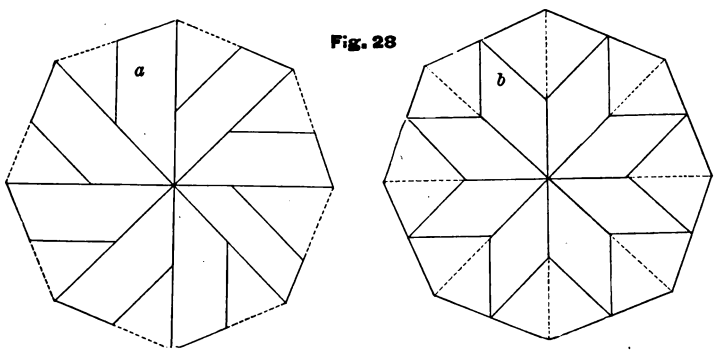


Fig. 28

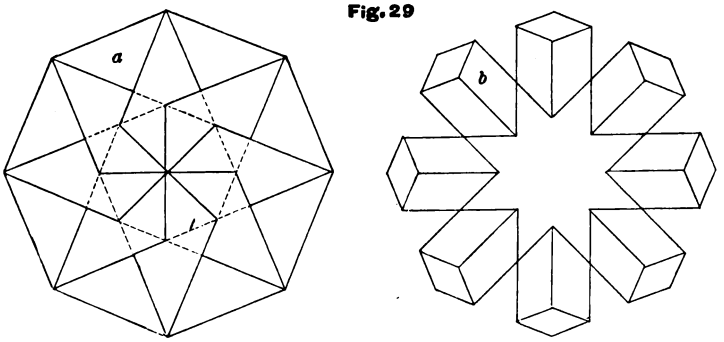
After the second direction, as above, this design may be varied, as follows:

Third. Draw lines from the dots upon each diagonal to the centre of the two sides nearest.

Fourth. Erase the outer half of each diagonal, and we have *b*, Fig. 28.

Another simple design may be made by drawing parallel diagonals from the extremities of each line to the side opposite, and by drawing diagonals through the centre to the angles of the interior octagon formed by the intersection of the first diagonal, as in *a*, Fig. 29. The dotted lines are those to be erased.

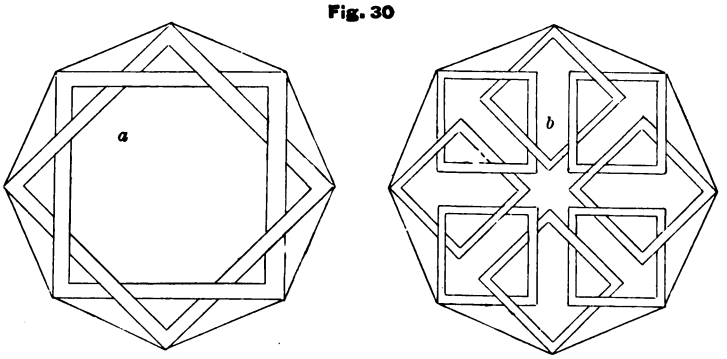
Fig. 29



By trisecting the exterior lines, drawing diagonals through the centre from each angle, and, from the points of trisection, lines to the opposite sides parallel to the diagonals, completing the rhomb, at the extremity of each diagonal, and by erasure, we have *b*, Fig. 29.

By drawing diagonals connecting alternate corners, two squares are formed; and by doubling the lines, and erasing the crossings on each square alternately, we have the squares intertwined, as in *a*, Fig. 30. Trisecting the

Fig. 30

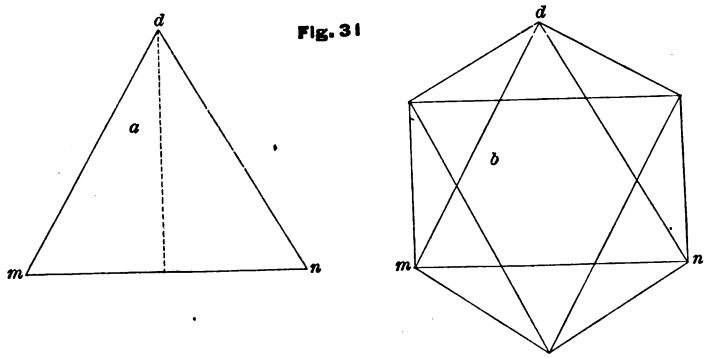


lines of the interior octagon, completing squares upon each half of the original squares, at the point of division, and erasing the crossings alternately, as before, we have *b*, Fig. 30.

Before proceeding to the next topic, a large variety of designs should be invented within the octagon.

EQUILATERAL TRIANGLES AND HEXAGONS.

A triangle having equal sides may be constructed by drawing a horizontal line, as *m n*, in *a*, Fig. 31, bisecting



it at *c*, erecting a perpendicular *c d*, indefinitely, and drawing the lines *m d* and *n d*, equal to *m n*. Such a triangle is called an *equilateral*.

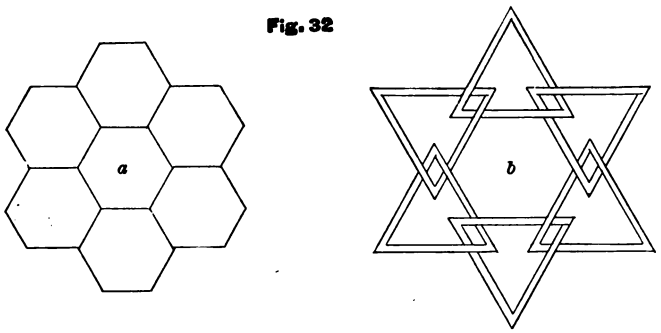
A hexagon may be drawn by first drawing an equilateral triangle, as *m n d*, in *b*, Fig. 31; trisecting each of its sides; connecting the points of division by lines, and continuing the lines outside the triangle until each pair meet. The result is a second equilateral triangle exactly equal to the first. By connecting the outer angles of these interlaced triangles, we have two regular hexagons, one outside the triangles and one within them.

DESIGNS BASED ON THE HEXAGON.

The relations of the sides of the hexagon are such as to admit of their being grouped together, like the cells of the honey-comb, as in *a*, Fig. 32. The hexagon and the equilateral triangle are the only polygons that can

be arranged in regular groups of the same size without loss of space.

Fig. 32

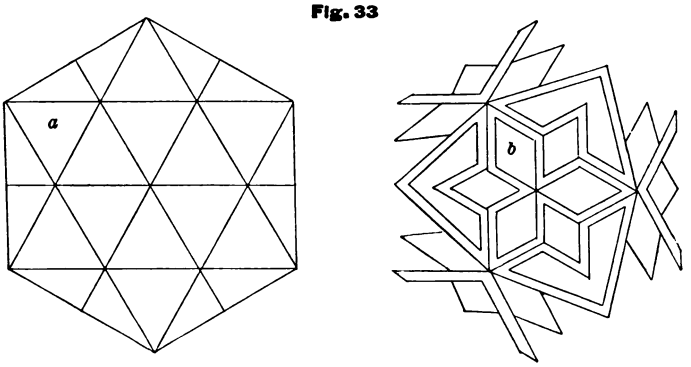


From this cellular arrangement a large number of designs may be constructed.

By taking the two equilateral triangles, which form the interior lines of *b*, Fig. 31, doubling the lines, trisecting the sides of the interior octagon formed, and connecting the points of trisection, we have the interlaced triangles, as in *b*, Fig. 32.

By drawing diagonals in various directions, we get patterns upon which any number of designs may be constructed. These patterns admit of great variety, and the

Fig. 33

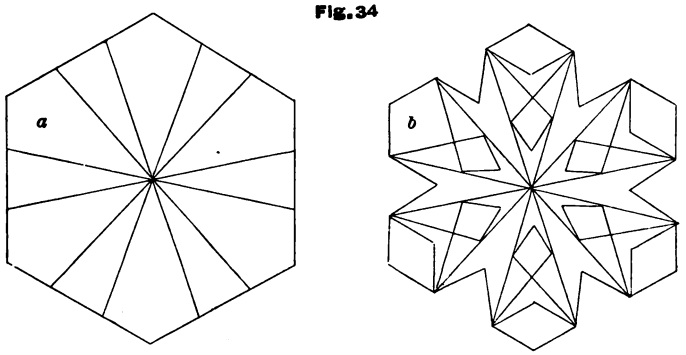


HEXAGONS WITH SIDES BISECTED.

designs that may be constructed are almost limitless. The combination of hexagons in groups will still increase the variety, and will afford scope for the most skilful in inventive work.

Specimens of the patterns and designs that the pupils may invent are given in Figs. 33 and 34.

Fig. 34

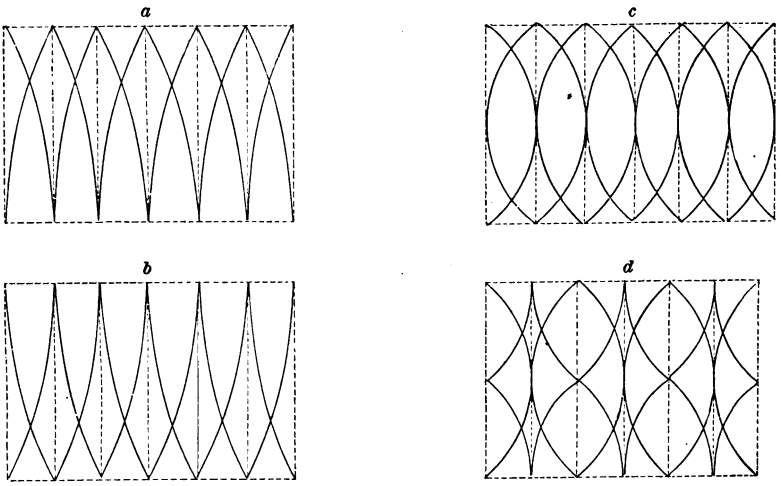


HEXAGONS WITH SIDES TRISECTED.

CURVILINEAR FORMS.

In the Synthetic Series full directions are given for drawing curved lines, which need not be repeated here. Before proceeding further, however, the pupil should be made familiar with the different curves and the methods

Fig. 35



of making them. To accomplish this, there should be regular practice, and a few diagrams are appended to make this practice systematic.

In Fig. 35, a rectangle is divided into smaller rec-

tangles with their greatest length in a vertical direction, and within these divisions the curves are drawn:

First. Between each of the lines an arc is drawn, forming concave angles at the top and convex angles at the bottom, as in *a*, Fig. 35.

Second. Between similar lines arcs are drawn, forming convex angles at the top and concave angles at the bottom, as in *b*.

Third. Arcs are drawn upon each line, extending from one extremity to the other, forming concave angles at both extremities, as in *c*.

Fourth. Curves are drawn alternately from the extremities and the centres of the lines, forming both concave and convex angles, as in *d*.

Careful practice in drawing these curves upon blackboard, slates, and paper, will secure accuracy in the construction of designs which may afterward be invented.

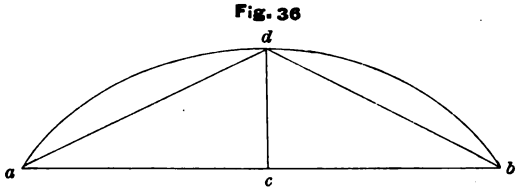
It will be seen that the curves in the above diagrams are such as are frequently observed in iron railings.

BISECTION OF ARCS.

A straight line connecting the extremities of an arc is called a *chord*.

To bisect an arc, as *a d b*, Fig. 36, draw the chord

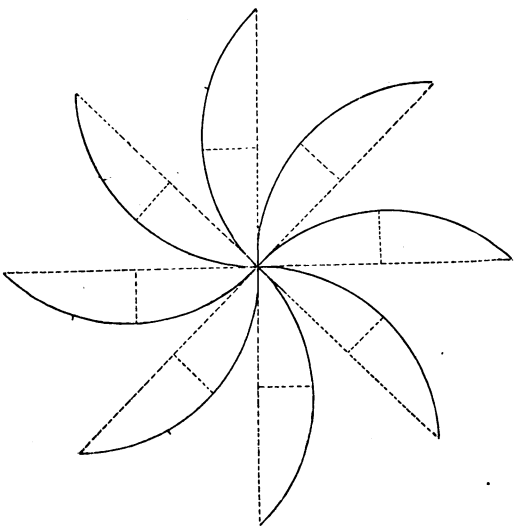
Fig. 36



a b, and bisect it at *c*. From the point *c* erect the perpendicular *c d*, and the point *d* bisects the arc. Each part of the arc may again be bisected by drawing the chords *a d* and *d b*, and proceeding as before.

The division of arcs extending in different directions into two and four equal parts, is illustrated in Fig. 37.

Fig. 37



This diagram might with profit be drawn by all the pupils upon the black-board and slates; and it can be easily given as a dictation exercise.

TRISECTION OF ARCS.

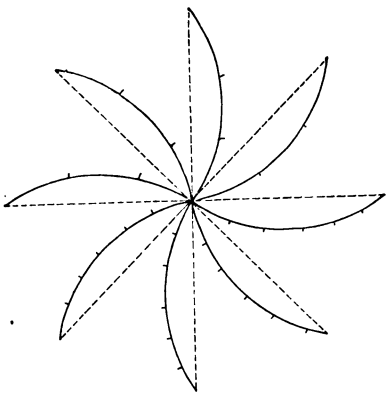
The trisection of arcs must be performed by the careful comparison of one part with another. It will require a considerable practice to gain sufficient skill to do this with accuracy.

In Fig. 38, a diagram is given for practice, made up of arcs lying in different directions, and this should be placed upon the board, and the arcs divided into three or six equal parts.

In practice, it will rarely be found necessary to divide arcs into any number of equal parts of which two and

three are not factors; and consequently no more exercises in the division of arcs are given.

Fig. 38

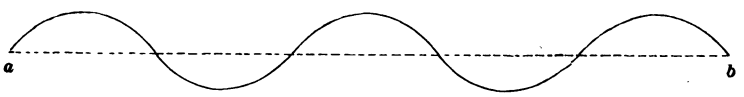


WAVING LINES.

Waving lines are made up of arcs alternately curving in opposite directions.

To draw a waving line, first draw a straight line, and divide it into any number of equal parts, as *a b*, Fig. 39.

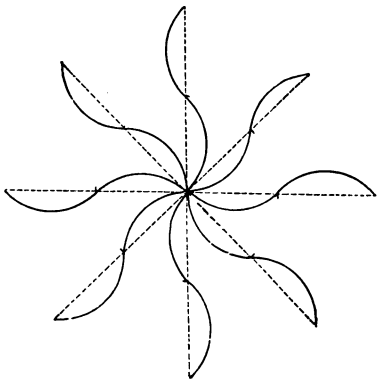
Fig. 39



Upon the left-hand division, as a cord, draw an arc with the convex side upward, and upon the next division draw an arc in the opposite direction, alternating the directions of the curve in each division. The result is the waving line represented in Fig. 39.

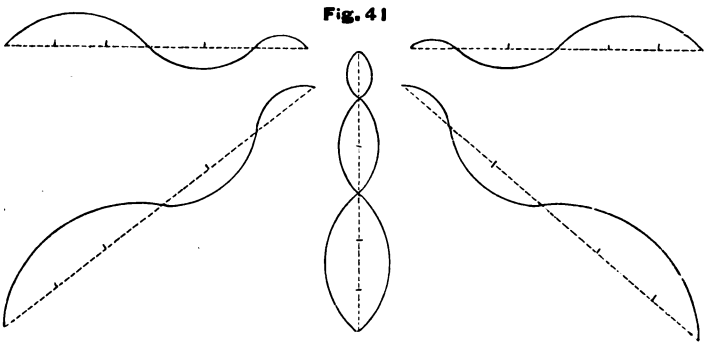
The manner of drawing waving lines lying in different direction, is illustrated by Fig. 40. This diagram can be used as a black-board and slate exercise.

Fig. 40



Waving lines may be made to gradually increase or diminish in the length of the curves of which they are composed, by dividing a line into any number of equal parts; and by drawing the first curve over several of these parts, the next one over one less, and so on, as is represented in Fig. 41.

Fig. 41



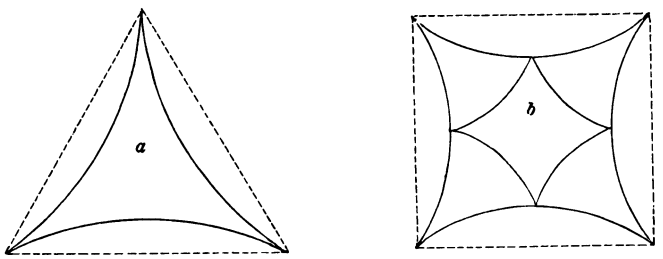
CURVILINEAR POLYGONS.

Regular curvilinear polygons may be made by first drawing the corresponding rectilinear figure, and then drawing arcs upon each line taken as a chord. The angles in each case may be convex or concave, but, in

practice it will be found that the convex angles will furnish the most tasteful figures.

In *a*, Fig. 42, we have an equilateral curvilinear

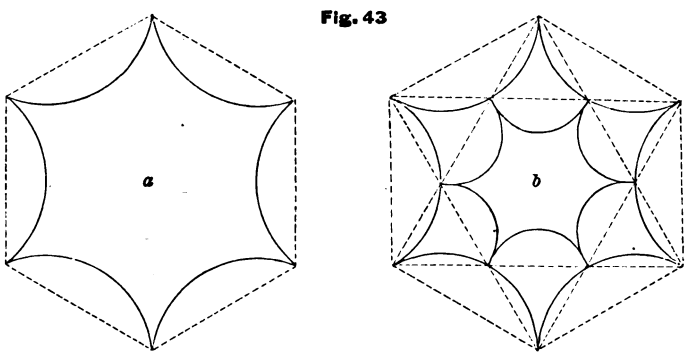
Fig. 42



triangle with convex angles, and in *b*, is represented a curvilinear quadrilateral with equal sides and convex angles, and a similar figure inside formed by uniting the centres of each of the sides by curved lines.

A curvilinear hexagon may be formed by first drawing a regular hexagon with straight sides, as in *a*, Fig. 43,

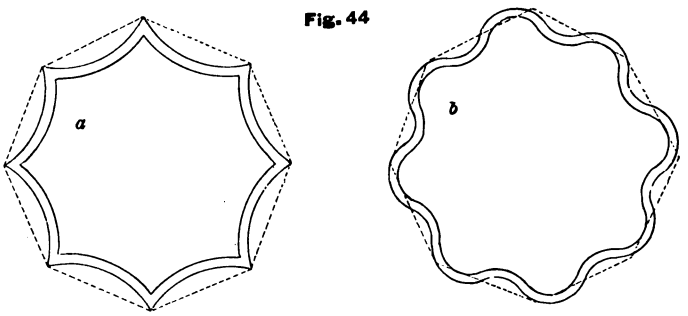
Fig. 43



or by uniting two equilateral triangles, and connecting these angles, as in *b*. An interior hexagon may be drawn by uniting the centre of the sides of the exterior polygon by curved lines, as in the last-named figure.

A regular curvilinear octagon may be made by first drawing a rectilinear octagon, and then drawing curved lines on each of its sides, as in *a*, Fig. 44; and a figure

Fig. 44



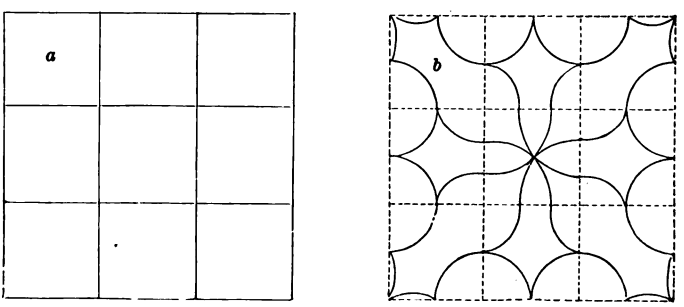
somewhat similar in outline, but without angles, may be formed by substituting waving lines for the straight lines of the original octagon, as in *b*, Fig. 44.

CURVILINEAR DESIGNS.

The next step in the course is to invent figures made up of curved lines. For this purpose, the different polygons are taken as a basis for outline and division, and the invention proceeds in the same manner as when straight lines are used.

For example, a square may be divided, as in *a*, Fig.

Fig. 45



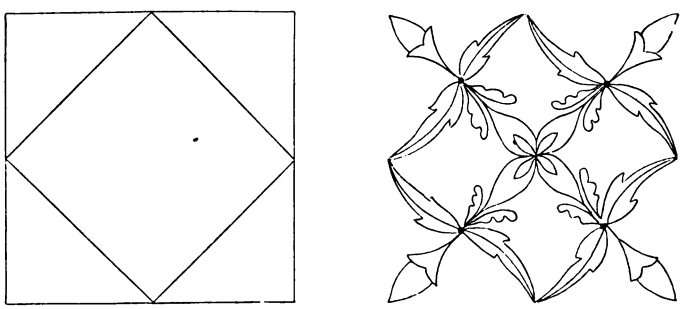
45, and curved lines drawn uniting the corners and centres of the sides of the smaller squares, all the lines converging toward the centre, forming the design represented by *b*, Fig. 45.

We append several of these designs within the square, showing what all pupils may invent, if they follow out the course of instruction here presented. It will be noticed that the designs with curved lines will serve to cultivate taste to a much greater extent than those which are composed of straight lines only.

It will be further noticed that curved lines serve to express the form of nearly every variety of natural object, and that, in drawing from Nature, they are used almost exclusively.

In *a*, Fig. 46, we have a pattern of a square with sides

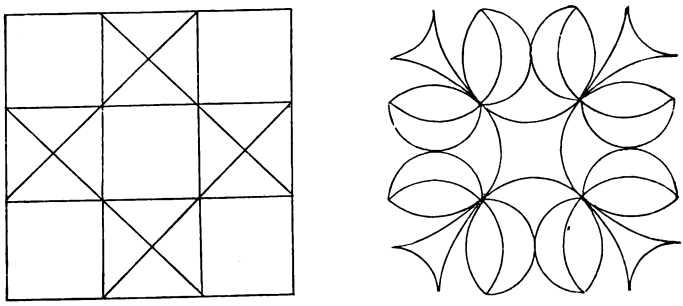
Fig. 46



divided into two equal parts, with a few lines to guide in the construction of the design *b*.

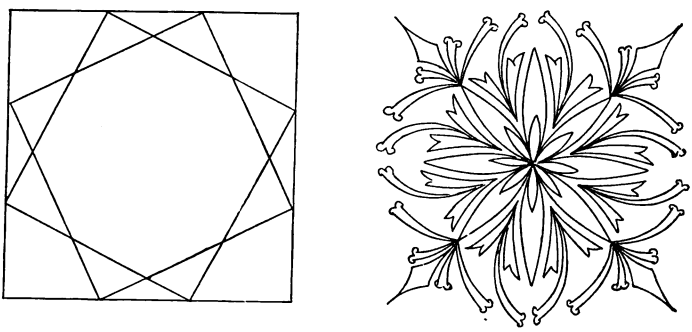
In Figs. 47 and 48 the sides are divided into three equal parts, and in Figs. 49, 50, and 51, the sides are divided into four equal parts. Other patterns and designs may be constructed by dividing the sides of a square into five, six, or eight equal parts; and in this manner a great variety may be obtained.

Fig. 47.



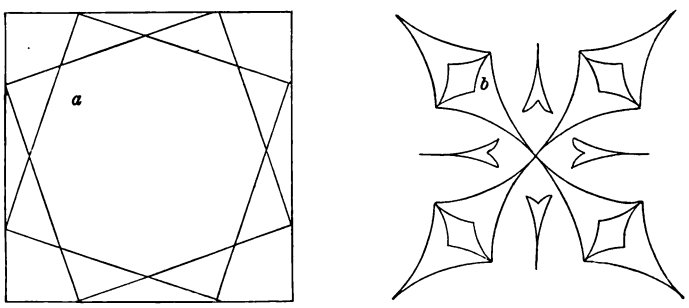
Division into Three Parts.

Fig. 48



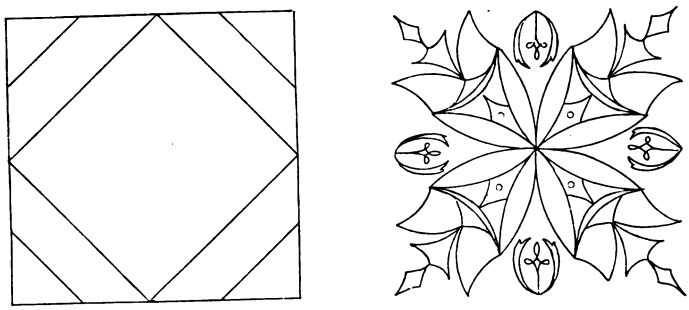
Division into Three Parts.

Fig. 49



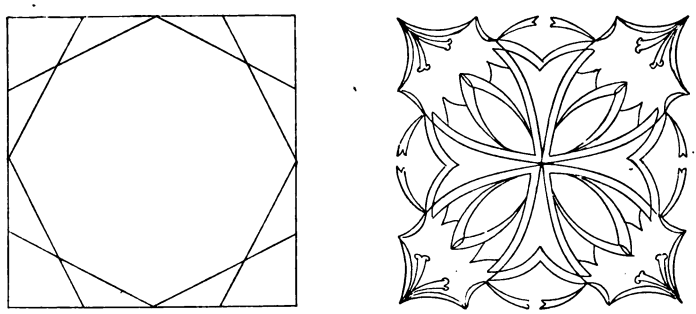
Division into Four Parts.

Fig. 50



DIVISION INTO FOUR PARTS.

Fig. 51

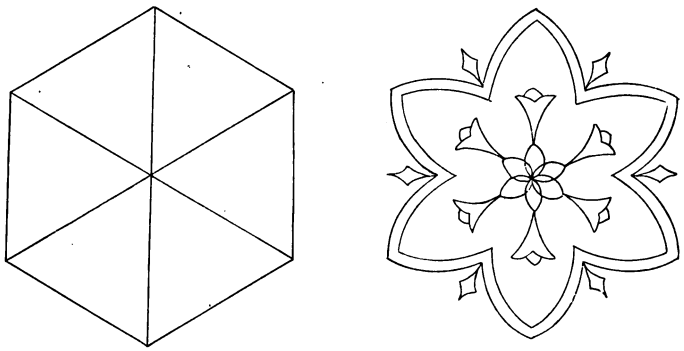


DIVISION INTO FOUR PARTS.

The hexagon and octagon have outlines admirably adapted for the giving form to tasteful designs. With these figures, patterns are drawn as with the square, and upon the patterns the designs are constructed. A few specimens are appended, showing what may easily be done in this direction.

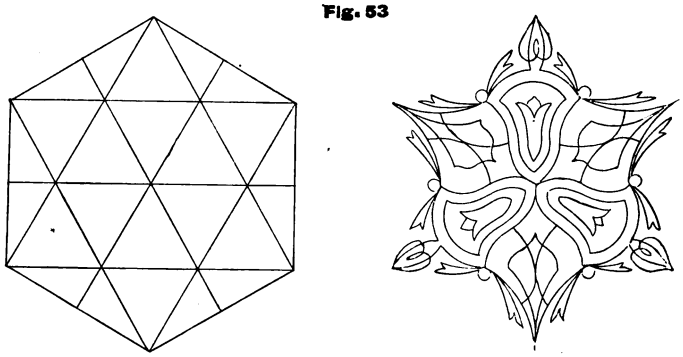
These figures are similar to those so largely used in the manufacture of carpets and paper-hangings, and the construction is an important part of the work of designing.

Fig. 52



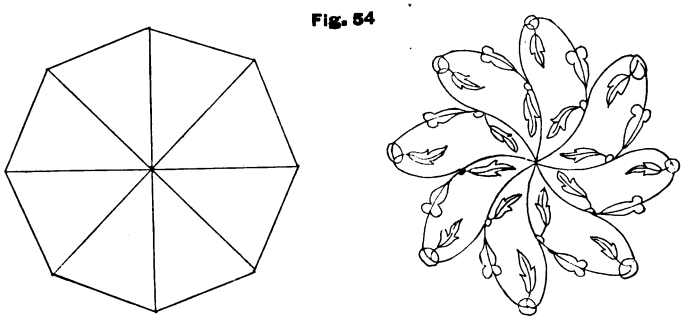
HEXAGON PATTERN AND DESIGN.

Fig. 53



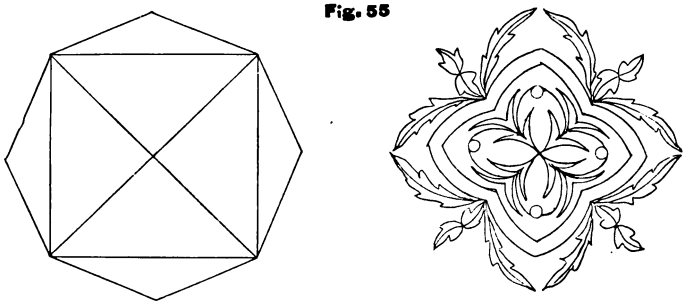
HEXAGON PATTERN AND DESIGN.

Fig. 54



OCTAGON PATTERN AND DESIGN.

Fig. 55



OCTAGON PATTERN AND DESIGN.

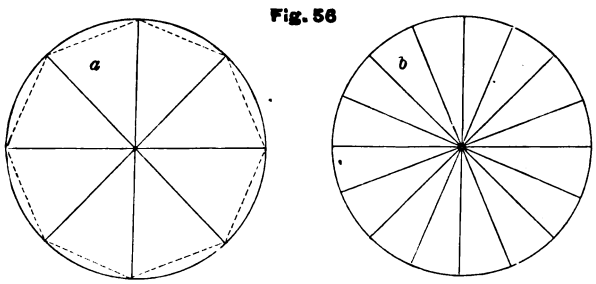
THE CIRCLE.

A *circle*, considered mathematically, is a space surrounded by a curved line every point of which is equally distant from a point within called the centre.

In common language, and generally in drawing, the term circle is used to represent the line enclosing the space, rather than the space itself.

The circle is the most regular of all figures, and it is also the most difficult to draw accurately without the aid of instruments.

Fig. 56



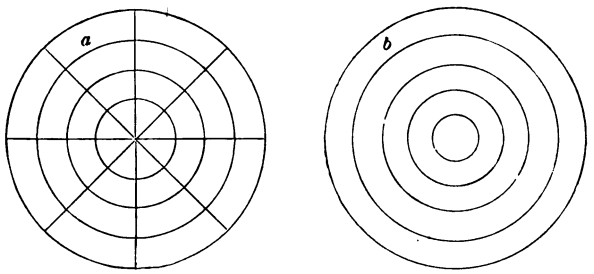
A circle may be drawn with tolerable accuracy by constructing an octagon, as in Fig. 27, and drawing uniform curves through the angles, as in *a*, Fig. 56. By subdividing the angles of the octagon and drawing lines

marking these subdivisions equal in length to the diagonals of the octagon, as in *b*, Fig. 56, the curves can be made more uniform and the circle more nearly perfect.

In this case the point of division of the angles will become the centre of the circle; the diagonals will be *diameters;* and the lines from the centre outward will be *radii.*

After the pupil has practised until he can draw a circle with tolerable accuracy, he should draw a large circle with smaller ones inside, as in *a*, Fig. 57, the subdivision of the diameters furnishing a guide to each circle. After this is done, he should next draw the con-

Fig. 57

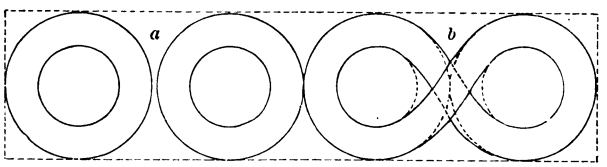


centric circles, as in *b*, Fig. 57, without the aid of diameters, being guided solely by the equal spaces between the circles.

CONNECTED CIRCLES.

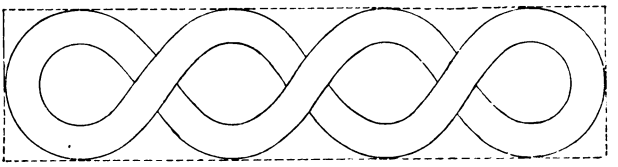
Circles of uniform size arranged in a line, as in *a*, Fig. 58, may be interlaced with each other by connecting

Fig. 58



the exterior lines of the one with the interior lines of the other, as in *b*, Fig. 58. The dotted lines, showing the

Fig. 59

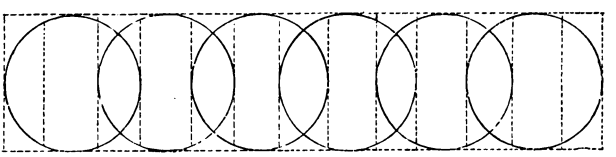


original form of the circles are to be erased. When several circles are united in this manner, they form a connected design, as in Fig. 59.

A chain composed of circles linked together may be drawn, as follows:

First. Draw a number of circles of uniform size in a line, overlapping each other one-third of their diameters, as in Fig. 60.

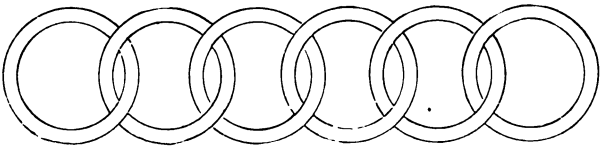
Fig. 60



Second. Within each of these circles draw a second circle, making the space between the outer and inner circles less than one-sixth of the diameter of the outer circle.

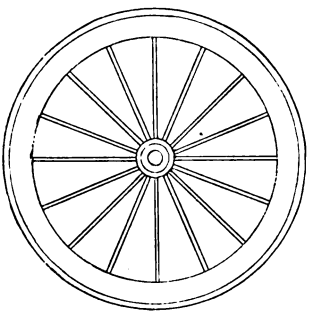
Third. Erase the lines that intersect alternately in each circle, and the result is the chain, as represented in Fig. 61.

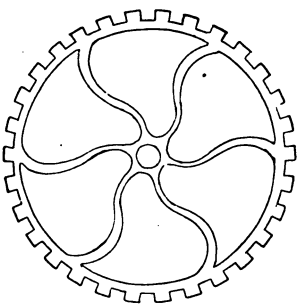
Fig. 61



Circles with a few additional lines may be made to represent a great variety of useful articles, as the wheels shown in Fig. 62.

Fig. 62



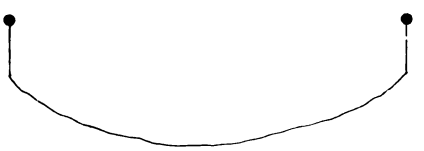


THE ELLIPSE.

The *ellipse* is best constructed by the use of a simple apparatus.

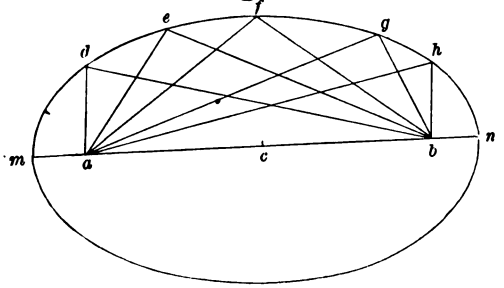
Place two pins upon the black-board or paper, with a string attached, more or less loose, according to the relative width of the ellipse to be produced, as in Fig. 63.

Fig. 63



Place a crayon or pencil in the fold of the string, pressing outward until the string is stretched tightly, and move it around the pins until a curved line is completed. The figure thus formed is an ellipse, as represented in Fig. 64. The position of the pins, as *a* and *b*,

Fig. 64

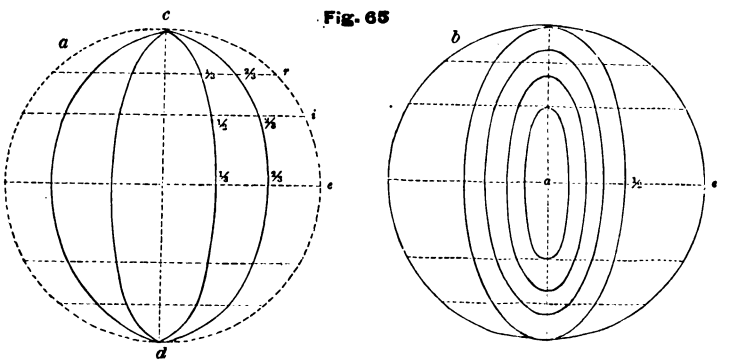


are the foci of the ellipse; and the sums of the two lines from the foci to any point in the circumference, as *d* and *e*, are equal, as they always represent the length of the string.

The teacher should draw an ellipse on the board, so that the pupils may get a correct idea of its form and parts; and the pupils, in their turn, should draw it by the use of the apparatus, as described.

The same result may be obtained without the use of apparatus, by drawing a circle, as in *a*, Fig. 65, and draw-

Fig. 65



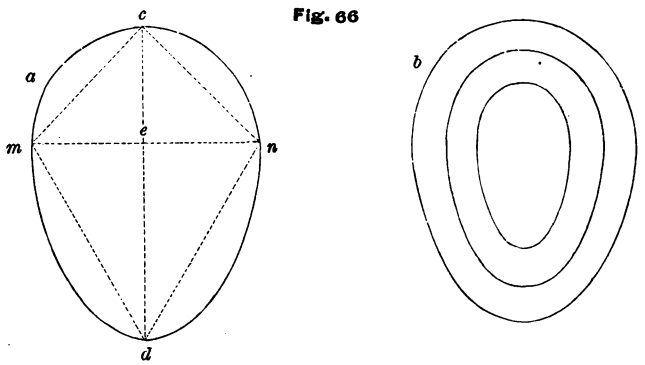
ing through it a diameter, as *c d*. Then draw parallel lines through the circle, at right angles with the diameter; divide these lines proportionally, as represented in the figure; and connect the points of division and the extremities of the diameter, and the result is the ellipse.

For variety in practice, several concentric ellipses should be drawn, as in *b*, Fig. 65.

THE OVAL.

The *oval* may be constructed by drawing a vertical line, as *c d*, in *a*, Fig. 66; dividing it into unequal parts

Fig. 66



at *e*, making *c e* less than *e d*, say one-half; then drawing *m n* through *e* at right angles with *c d*, and double the length of *c e*, and connecting the points *m n* and *c d* by regular curves. This gives the egg-shaped or oval form, as represented in Fig. 66. As this form is of frequent use in the applied course, the pupils should draw it until they are able to produce it with considerable accuracy.

The exercise may be profitably varied by drawing several ovals, one large one, and several others within, as in *b*, Fig. 66. The lines in this case must be kept exactly parallel.

In Fig. 67, we have a design showing how a flower-garden may be tastefully arranged in the general form of an ellipse. The pupils should be encouraged to invent other designs of a similar character.

Other forms than the elliptical may be taken as the basis for arranging a garden or a lawn, and, in this direction, a series of valuable exercises may be given. In this manner pupils may be led to a careful observation of form, as is illustrated in gardens with which they are acquainted, and to acquire taste and practical skill in the laying out of grounds. This affords another illustration of the value of drawing as leading to the study of an important department of practical science.

We append a few miscellaneous designs to illustrate still further the great variety which may be invented on the basis of the work already accomplished:

Fig. 67

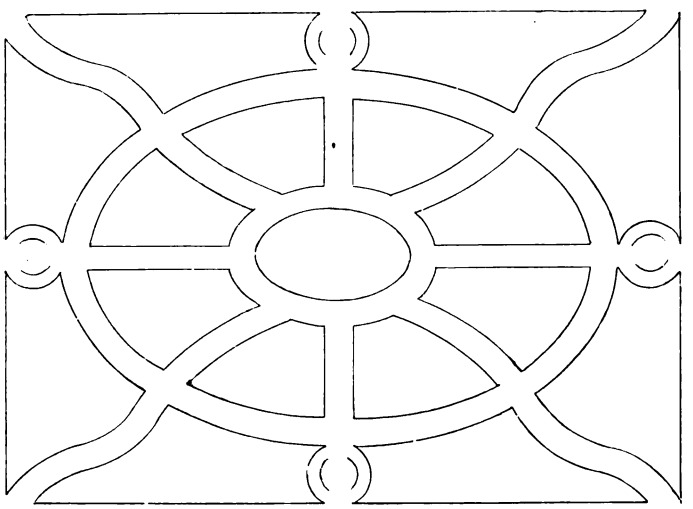
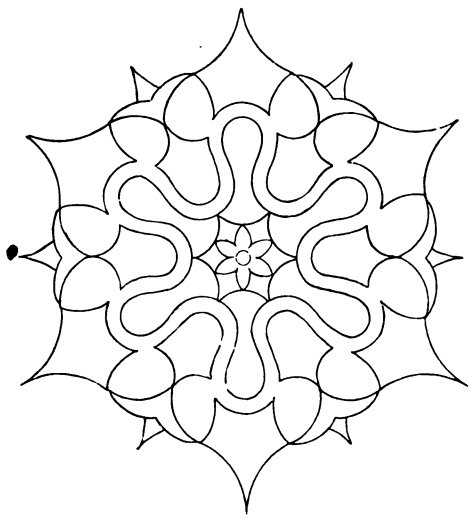
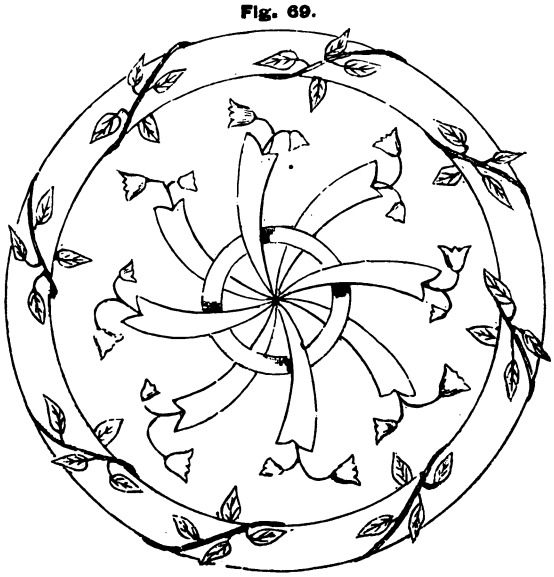


Fig. 68



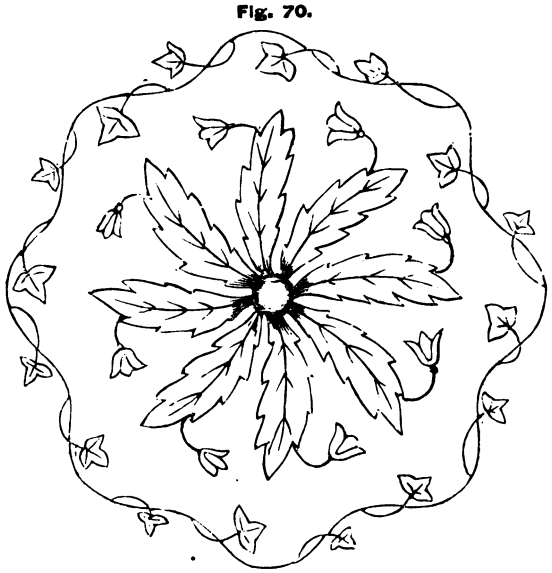
Plain Hexagonal Design.

Fig. 69.



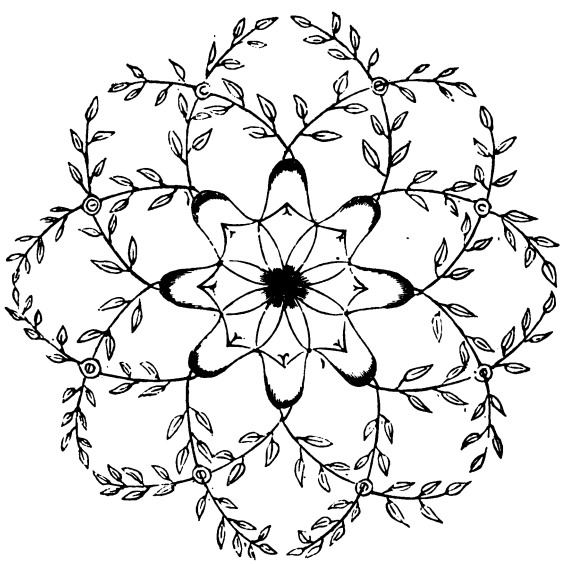
Circular Design with Wreath and Flowers.

Fig. 70.



CIRCULAR DESIGN WITH LEAVES AND FLOWERS.

Fig. 71.



CIRCULAR DESIGN WITH WREATHS.

APPLIED COURSE.

In the Inventive Course of this series, the pupils are taught to invent and construct forms, within certain definite and fixed limits. Each step in this inventive work should be succeeded by a step in copying, where the principles developed are applied to the delineation of actual forms.

The copies in the drawing-books are arranged in the same general order as the lessons in the Manual, so that, in teaching, the exercises may be taken from each alternately. The copies are also so classified as to reach out as far as possible into the different departments of art and of natural history. Familiar forms of common objects and utensils, of vegetation, and of animal life, are given in outline, to familiarize the pupil with the general proportions of each, and with the technical method of drawing similar forms directly from the objects themselves, and as preliminary to success in the higher fields of art.

BOOK I.

This book consists mostly of rectilinear forms, all of which are contained within the limits of definite geo-

metric figures, and the parts of which are obtained by regular divisions and subdivisions.

Each design should be put upon the board and thoroughly analyzed by the class, so as to determine its proportions, and the regular figure within which it may be drawn. Each pupil should then construct this approximate figure, and draw the design, first upon the slate or an extra piece of paper, and afterward in the book.

For example: the ladder, upon page 1, is drawn by constructing a rectangle, five parts high and four parts wide; dividing the horizontal lines into three equal parts; and drawing diagonals from the right-hand upper corner to the left-hand lower division; and from the right-hand upper division to the left-hand lower corner.

The remaining designs upon page 1, and those upon page 2, are all contained within squares, the parts being regular divisions of the squares. The designs upon pages 3 and 4 are all contained in rectangles, three parts long and two parts wide.

The designs upon page 5 are composed of regular figures, all divided into definite proportions. Let the pupils ascertain these figures and proportions, describe them, and then draw them.

All the designs up to page 11 are of similar character, and each one should be carefully studied and analyzed by the pupil, before it is drawn.

Upon pages 11 and 12, curved lines are introduced in connection with the straight lines. The proportions and divisions of the railings upon page 12 should receive particular attention.

BOOK II.

This book is composed of designs made up largely of curved lines. Each design, however, may be drawn

within the limits of a regular rectilinear figure; and, as in Book I., the pupils should be taught to find the figures and proportions of each.

Upon several of the designs, the approximate figures showing the form and proportions are represented by dotted lines, as an aid to the pupil in analyzing them.

For example, the tub and bucket, upon page 1, are contained within rectangles; and each side of the scales on page 2 is an isosceles triangle. The household articles upon pages 3, 4, and 5, are best made by drawing vertical and horizontal lines, as is indicated in the first design upon page 3. The vases upon pages 6, 7, and 8, all have definite proportions, and the method of measuring and drawing them is sufficiently indicated by the dotted lines.

The designs upon pages 10 and 11 are strictly mathematical in their form and proportions, and they should be measured and drawn with great accuracy.

BOOK III.

The designs in Book III. consist entirely of vegetable forms, all having irregular outlines. While each one may be drawn within definite limits, yet Nature is so bountiful in variety of form, that slight variations are admissible. In a few cases, approximate figures are represented by dotted lines, but generally the analysis has been left to the pupil.

The designs in this book are for the double purpose of giving the pupil practice in drawing irregular curves, and of familiarizing him with the forms of leaves and flowers, so that he may be able to distinguish their characteristics and differences, and to draw similar ones from Nature.

Lessons upon leaves may be given upon the basis of the division of angles. For example: an indefinite vertical line is drawn, as *a b*, Fig. 1, page 1. From its lower extremity horizontal lines are drawn to the right and left, as *b c* and *b d*, each half the length of the vertical line. The right angles formed are next bisected by the lines *b e* and *b f*, each three-fourths as long as the vertical line. These five lines drawn, form the principal veins of the maple-leaf. The deep indentation extends downward to the middle of the mid-vein, and the distance from the centre is about one-fifth of the length of the mid-vein. The remainder of the leaf can now be readily drawn, by carefully observing the kind and direction of the indentations.

Other leaves may be analyzed and drawn in a similar manner. After each lesson in copying, the teacher should encourage the pupils to find other leaves of like character, and to copy them. The flowers should be treated in the same way. The copies simply give the technical manner of expressing flowers; the true work is drawing flowers from Nature after the technical language is mastered.

BOOK IV.

This book consists entirely of the forms of the lower animals, including radiates, mollusks, articulates, and the lower orders of the vertebrates. The designs are brought within more definite limits than those which represent vegetation, but many of them are still irregular.

The radiates and mollusks, represented on the first three pages, have fixed forms as individuals, but no two of the same species can be found without marked and striking differences.

Upon page 4 we have the larva and chrysalis-form

of the tobacco-worm, and in Fig. 2, page 7, we have the moth-form of the same insect.

In connection with the lessons in drawing the insects found upon pages 5, 6, 7, and 8, the names of the different species represented should be ascertained, and others of like character should be sought, and when found they should be analyzed and drawn.

The same method should be pursued with the designs upon the remaining pages of the book. First, the picture should be analyzed and drawn, and then other objects belonging to the same or similar species should be found, compared with those represented in the drawing, and carefully drawn. In this way many minute differences will be discovered that would otherwise remain unnoticed.

BOOK V.

As we approach the higher animals, we find that forms assume more definite proportions, and that it is often quite possible to express them in simple geometric figures. By drawing the figures and the designs, they may become so associated that the one will suggest the other, and pupils may be easily taught to draw the most familiar animals from memory.

In most of the designs of the book approximate figures and lines are given, to assist the pupil in getting these definite ideas; and, in every case, he should study the figure attentively, compare the different lines and angles with each other, and observe the relations which exist between the lines and points, and the parts of the animal.

For example: in Fig. 1, page 1, the angle *a b c* is a right angle; the lines *a b*, *b c*, *c d*, and *c g*, are all equal; the lines *e d* and *g h* are each equal to one-half of *a c*;

and the line *f d* is three-fourths of *a b*. The two curves *b g d* and *c e f* are semicircular.

In Fig 1, page 2, *a b c* is a right-angled triangle, with the base and perpendicular equal; *a d* is one-fourth *a b; e d* and *d f* are equal to *a d;* and *g h* is equal to *a e.*

In Fig. 2, page 3, the figure *a c b* is the half of an ellipse, of which *c d* is equal to one-third *a b; a e* is equal to one-fourth *a d*, and *f e* is equal to *c d.*

In Fig. 2, page 6, the figure *a b c d* is a rhomboid, in which *b d* is half of *a b;* the line *d e* is one-fourth *b d.* The eye is in the centre of the line *a b.*

The heads of dogs can usually be represented by right-angled triangles, the hypothenuse of which will extend from the top of the head to the tip of the nose. The eye is found in the middle of this line.

It will be seen that in representing the Newfoundland dog, Fig. 1, page 6, the base and perpendicular are equal. By extending the base we get the proportions of the pointed-nose dogs like the greyhound, and, by diminishing the base, we obtain the proportions of the dogs with thick muzzles like the bull-dog.

The proportions in all the designs upon pages 7, 8, and 9, can be so readily seen that descriptions are unnecessary.

In constructing the diagram for the lion's head, Fig. 2, page 10, in the right-angled triangle *a b c*, the line *b c* is three-fourths of *a b*, and the length of the oblong is twice the width. The eye is at the middle of the upper long line.

After each lesson in copying, the pupil should examine the proportions of other animals, construct auxiliary figures, and draw directly from Nature.

BOOK VI.

In the delineation of the human figure, two features are particularly noticeable; the soft and undulating character of the outline, and the definite proportions which the different parts sustain to each other and to the whole.

From a very early period artists have endeavored to discover some model of the human form which should serve as a standard of physical perfection. Although this search has never resulted in complete success, and there are still diversities of opinion upon minor details, yet there seems to be a substantial agreement in regard to the general proportion which ought to exist between the different members of the body. This proportion varies with sex, age, and race, but, by becoming familiar with a definite model, it is comparatively easy to make the changes necessary to represent different individuals. The standard of proportions here given are those adopted by Gerard de Lairesse.

OUTLINES OF THE HEAD.

The general outline of an adult head is that of an oval, as seen in Fig. 72; while that of a child often more nearly approaches an ellipse, as seen in Fig. 73.

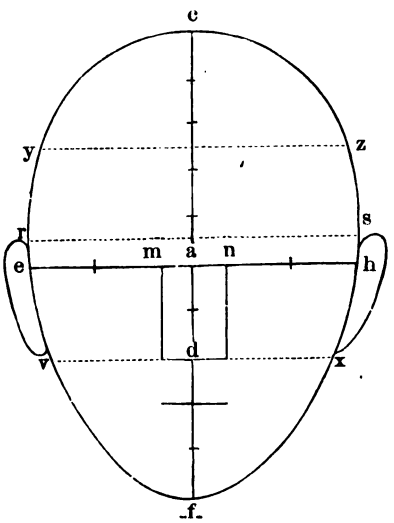
The proportions of the head of an adult and its several parts may be obtained in the following manner:

Draw a vertical line *c f*, and divide it into ten equal parts.

Through the central division draw a horizontal line equal to seven of these divisions, extending it equally upon each side.

These two lines will represent the extreme height and width of the head, and the horizontal line will represent the place of the eyes:

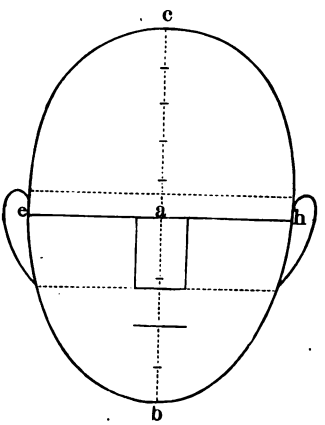
Fig. 72.



Divide the horizontal line into five equal parts. The two-fifths, *m n*, represents the width of the nose, and the two-tenths of the vertical line, *a d*, represents the length of the nose.

The mouth is situated one-tenth below the nose, and is of the same width as the nose.

Fig. 73.



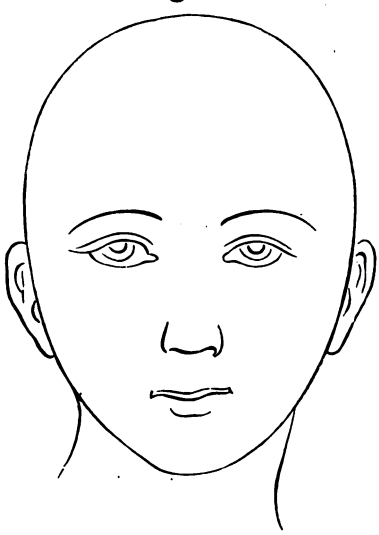
The line *y z*, drawn through the centre of *a c*, divides the space above the eyes into two equal parts, and represents the position of the upper part of the forehead.

The line *r s*, half of one-tenth above *e h*, represents the line of the eyebrows, and its extremities mark the position of the top of the ears.

The line *v x*, drawn through the lower extremity of the nose, shows the position of the lower part of the ears.

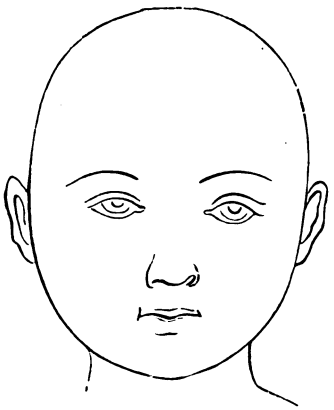
In the outline of the child's head, Fig. 73, the proportions are slightly varied. The oval is nearly changed to an ellipse; the nose occupies about one-third, instead of two-fifths, of the lower part of the face; and the space below the nose is divided into three equal parts, the upper division marking the position of the mouth. The remaining divisions are the same as in Fig. 72.

Fig. 74.



In Fig. 74, we have an adult head with the features drawn in the proportions above given; and, in Fig. 75, we have a more full representation of the head of a child.

Fig. 75.



These proportions will not apply to every head, nor do the heads in the applied course exactly conform to this standard. Pupils would do well, however, to fix these proportions in their memory, so that they can draw an ideal well-proportioned head at will. In drawing a real head, then, their only care will be to decide in what particulars it differs from the standard.

Upon page 1, a foot is represented in two positions; and, in each one, the general outline is shown by a right-angled triangle, the lines including the right angle being in the proportion of 2 to 1. The right angle is at the bottom of the heel, the long side terminates at the toes, and the short side at the ankle.

The hand upon page 2 is best expressed by an oblong, with the sides in the proportion of 2 to 1. A line dividing the oblong into two equal parts gives the position of the lower part of the thumb, and a line, one-third of the distance from the centre to the left, marks the position of the lower extremities of the fingers. Dividing the latter line into four equal parts, we obtain the divisions of the fingers.

The fact that the length of the hand is twice the width, is indicated in the drawing, and it can be verified by an examination of the hand itself. The span of the hand between the thumb and the middle finger is usually about one inch greater than the length of the hand; a fact of importance when measurements are to be made, and no instruments are at hand for the purpose.

Two faces are represented upon page 3, one looking downward and the other upward. The proportions of these may be found by drawing a line from the pupil of the eye to the chin, and, from the centre, drawing a line to the right, one-third the length of the base-line. The right extremity of the latter line will indicate the position of the point of the nose, and the intersection of the two the position of the lower part of the nose.

The heads of an infant and of a youth are shown upon page 4. In the former the elliptical shape of the head, the great height of the upper part of the face, and the relative shortness of the nose, are particularly noticeable.

The figures upon page 5 are a celebrated Madonna, and Raphael, the great painter. It will be noticed that the eyes are uncommonly large, a feature characteristic of the nations of Southern Europe.

The heads of Franklin and Washington are represented upon page 6. The former expresses reflection and thought; and the latter, courage, determination, and watchful activity.

OUTLINES OF THE ENTIRE HUMAN FIGURE.

A well-proportioned man is represented upon page 7. By reference to the vertical line to the right, it will be seen that, taking the height of the head as a unit, the entire body is seven and a half units high. The legs are nearly as long as the trunk and head combined; the

arms measure three units, and the hand three-fourths of a unit, or the length of the face.

Allowing a unit and a half for the width of the body between the arms, a man with outstretched arms can span the length of his body, or seven and a half units. The knee is about the middle of the leg. The length of the foot was formerly reckoned as one-sixth that of the body, though with the cultured races this proportion is now considerably less, owing, no doubt, to the fact that the foot rarely has opportunity for full development.

In the figure of the child represented upon page 8, the proportion of the height of the whole body to that of the head is 4½ to 1; in the figure of the girl upon page 9, 5½ to 1; and in that of the boy upon page 10, 6 to 1.

A mature woman is represented upon page 11, the proportions being 7 to 1. The figure upon page 12 shows some of the changes incident upon time, and presents the bent stature and sharpened features and fingers, characteristics of extreme old age.

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